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(54) LUBE BASE OIL AND ITS PRODUCTION

(57)Abstract:

PURPOSE: To obtain a lube base oil which has a viscosity index high enough, a low arom. content, and an excellent stability (e.g. to heat, light, oxidation, or shear).

CONSTITUTION: This lube base oil is based on a hydrocarbon and has a b.p. of 300-520° C under normal pressure, a total arom. content of 1.8 wt.% or lower, a kinematic viscosity of 15-25mm²/s at 40° C, a viscosity index of 107 or higher, a flow point of -10° C or lower, and an oxidation stability expressed by an RBOT value of 410min or higher when measured in the presence of 0.5wt.% 2,6-di-t-butyl-p-cresol (DBPC).

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CLAIMS

[Claim(s)]

[Claim 1] It is in the range whose boiling point in ** ordinary pressure it is lubricating oil base oil of a hydrocarbon system, and is 300–520 degrees C. ** Be in the range the amount of [whose] all aromatic series is 1.8 or less % of the weight and whose kinematic viscosity in **40 degree C is 15–25mm²/s. ** Lubricating oil base oil characterized by for a viscosity index being 107 or more, and for ** pour point being –10 degrees C or less, and the oxidation stability when adding **2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight being 410 minutes or more in a RBOT value.

[Claim 2] Heavy gas oil (HGO) and/or a vacuum gas oil (VGO) A silica alumina, It hydrocracks under existence of the hydrocracking catalyst which makes an alumina and/or a zeolite support and contains periodic-table 6 group's metal and/or eight to 10 group's metal. Carry out distillation separation of the decomposition product concerned at a fuel oil fraction and a lubricating oil fraction, perform dewaxing processing by solvent dewaxing and/or hydrogenation dewaxing to the lubricating oil fraction concerned, and a part for a wax is removed from this fraction. Under existence of the hydrogenation catalyst which makes a silica alumina and/or an alumina support for the obtained dewaxing lubricating oil fraction, and contains periodic-table 6 group's metal and/or eight to 10 group's metal A hydrogen treating is carried out on condition that total pressure 170–230kg/cm²G, the reaction temperature of 220–370 degrees C, and supply liquid-space-velocity (LHSV) 0.2–1.5hr⁻¹. The manufacture approach of the lubricating oil base oil according to claim 1 characterized by carrying out separation recovery of the fraction which is in the range whose boiling point in ordinary pressure is 300–520 degrees C by distillation from this generation oil.

[Claim 3] Heavy gas oil (HGO) and/or a vacuum gas oil (VGO) A silica alumina, It hydrocracks under existence of the hydrocracking catalyst which makes an alumina and/or a zeolite support and contains periodic-table 6 group's metal and/or eight to 10 group's metal. Carry out distillation separation of the decomposition product concerned at a fuel oil fraction and a lubricating oil fraction, and distillation separation of the fuel oil fraction concerned is carried out further at a light fraction and a heavy fraction. Dewaxing processing by solvent dewaxing and/or hydrogenation dewaxing is performed to a mixed fraction with a lubricating oil fraction and the heavy fraction concerned, a part for a wax is removed from this mixed fraction, and a dewaxing mixing fraction is obtained. Dewaxing processing by solvent dewaxing and/or hydrogenation dewaxing is performed to each of the lubricating oil fraction concerned and the heavy fraction concerned, a part for a wax is removed from each fraction, and a dewaxing lubricating oil fraction and a dewaxing heavy fraction are obtained. Subsequently Under existence of the hydrogenation catalyst which makes a silica alumina and/or an alumina support for the mixture of the dewaxing mixing fraction concerned or the dewaxing lubricating oil fraction concerned, and the dewaxing heavy fraction concerned, and contains periodic-table 6 group's metal and/or eight to 10 group's metal A hydrogen treating is carried out on condition that total pressure 170–230kg/cm²G, the reaction temperature of 220–370 degrees C, and supply liquid-space-velocity (LHSV) 0.2–1.5hr⁻¹. The manufacture approach of the lubricating oil base oil according to claim 1 characterized by carrying out separation recovery of the fraction which is in

the range whose boiling point in ordinary pressure is 300-520 degrees by distillation from this generation oil.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention For example, the automobiles and vessels by the gasoline engine, a diesel power plant, etc., or various kinds of lubricating oils (engine oil —) used for various kinds of industrial machines and equipments, such as a machine for construction / machining, etc. for the various purpose If it says in more detail about the lubricating oil base oil advantageously used for **, such as an ATF oil and various hydraulic oil, as base oil used as the principal component, and its manufacture approach Since it has a hyperviscous characteristic and the aromatic series content has the ideal physical properties and ideal engine performance as lubricating oil base oil, such as excelling in stability (heat, light, oxidation, shear stability, etc.) etc. very low By applying this as base oil, expansion of an application temperature requirement, improvement in stability and endurance, The physical properties as various lubricating oils and optimization of the engine performance can be attained easily, and it is related with the lubricating oil base oil and its suitable manufacture approach of the hydrocarbon system which can prepare easily the lubricating oil of the high performance which can be used in favor of the above-mentioned application.

[0002]

[Description of the Prior Art] In recent years, high-performance-izing of an automobile, an industrial machine, etc. and-izing corresponding to energy saving progress, and improvement in the engine performance of the lubricating oil used for them is called for strongly. The engine performance of a lubricating oil has the large place depended on the quality of the base oil used as the principal component, i.e., lubricating oil base oil, especially, in the lubricating oils for automobiles (engine oil, an ATF oil, hydraulic oil, etc.), the hydraulic oil of the machinery for construction / machining, etc., it excels in the stability over improvement in shear stability, expansion of an application temperature requirement, oxidation, heat, light, etc., and, moreover, lubricating oil base oil of the hydrocarbon system of hypoviscosity high performance is desired moderately.

[0003] In addition, as a cure of expansion of an application temperature requirement, it is desirable to make high the viscosity index of lubricating oil base oil, and let it be a good plan to make especially the improvement or the reservation of stability to oxidation, heat, light, etc. reduce an aromatic series content.

[0004] From the former, it was used widely, the approach, i.e., the solvent refining process, by solvent extraction, and if manufacturing the lubricating oil base oil of a hyperviscous characteristic according to this solvent refining process was also performed for many years, it came for manufacture of the lubricating oil base oil of a hydrocarbon system, or adjustment of physical properties. however, in manufacturing the lubricating oil base oil of a hyperviscous characteristic according to such a solvent refining process Since it generally is not easy to raise the viscosity index of a lubricating oil fraction greatly by solvent refining The class of a crude oil itself will be limited narrowly, and moreover, even if strict in the extraction condition, since an improvement and control of oxidation stability etc. of other physical properties were also difficult, fully attaining hyperviscous indexation had easily, the trouble of receiving a limit strong

against the physical properties and application of a product.

[0005] Then, as a means to manufacture the lubricating oil base oil of a hyperviscous characteristic, the approach of combining a solvent refining process and/or hydrotreating, and dewaxing processing with hydrocracking is proposed, and the attempt which is going to raise hyperviscous indexation and coincidence also as for the stability over heat, oxidation, etc. is comparatively made recently by reducing or controlling a part for aromatic series by solvent refining and/or the hydrogen treating in that case (refer to JP,3-223393,A, a 4-36391 official report, a 6-116571 official report, and a 6-116572 official report). Thus, with improvement in a viscosity index, the technical thought which is going to aim at improvement in stability by low aromatization deserves attention.

[0006] However, since it is hard to reduce an aromatic series content efficiently in any case, even if satisfied with an approach given in the above-mentioned official report of hyperviscous indexation, there will be a trouble that the reservation of stability to oxidation, heat, light, etc. is not easy. In above-mentioned JP,4-36391,A etc. although [dearomatic series processing / hydrotreating / the solvent refining process] it is desirable, since the rate of dearomatic series is low, in the lubricating oil base oil obtained, a part for the high-concentration aromatic series of 2 - 15 % of the weight is actually contained also by the solvent refining process. In such lubricating oil base oil of a high aromatic series content, the stability over sufficient oxidation, heat, light, etc. is not expectable. Moreover, although it is also expectable to raise the rate of dearomatic series so much if a solvent refining process and hydrotreating are combined better, the process for dearomatic series becomes complicated in that case, and an installed cost and a manufacturing cost become high. In addition, although improvement in the stability by dearomatic series is tried in JP,6-116571,A and a 6-116572 official report combining hydrotreating after the solvent refining process, sufficient improvement effect is not acquired like the above in fact.

[0007] On the other hand, the method of obtaining the low aromatic hydrocarbon oil which gives two steps of hydrotreating to a hydrocracking oil using the hydrogen-treating catalyst used regularly, and has lightfastness to it is indicated by JP,6-116570,A. By this approach, the 1st step of hydrogen treating is performed on condition that the reaction temperature of 290-355 degrees C, and the reaction pressure G of 50-150kg/cm², a part for aromatic series is reduced to 1 or less % of the weight, the 2nd step of hydrogen treating is performed on condition that the reaction temperature of 120-280 degrees C, and the reaction pressure G of 50-150kg/cm², and lightfastness is raised. It attracts attention apparently that a part for aromatic series can be reduced to 1 or less % of the weight by the hydrogen treating in such mild conditions. however, the example of this official report sees in this case -- as -- actual -- as the stock oil of the 1st step of hydrogen treating -- a hydrocracking oil -- MEK (methyl ethyl ketone) -- after performing dewaxing processing by law, it should be cautious of using what performed solvent-refining processing by the furfural further. Therefore, it is exactly the technique which combined a specific solvent refining process and specific hydrotreating like the above-mentioned technique after all also in this case. Namely, although the 1st step of hydrogen treating was performed in the example on the comparatively mild conditions of reaction pressure 80kg/cm²G and LHSV0.2hr⁻¹ and the amount of aromatic series has obtained the generation oil of the low value of 0.5 % of the weight by this approach This is because the good stock oil of the very specific description which performed dearomatic series processing by solvent refining special as mentioned above is used. After performing only dewaxing processing, without performing such specific pretreatment (solvent-refining processing by a furfural etc.) to stock oil, when a hydrogen treating is presented on the above mild conditions Generally it is very difficult to reduce a part for aromatic series to the low value of 0.5 % of the weight by one step of hydrogen treating.

[0008] Moreover, although the manufacture approach of a low aromatic hydrocarbon oil of having the target lightfastness in JP,6-116570,A is stated to the detail As an application of this hydrocarbon oil, the chief aim is set to the solvent for cleaning, the coating, the insecticide, or the solvent for ink. About a lubricating oil There is [that the boiling point (fraction 320 degrees C or more) of the stock oil with which hydrocracking is presented is only indicated, and] no explanation in any way in others, and nothing is actually indicated about the physical properties

and engine performance as the lubricating oil base oil or the lubricating oil of this hydrocarbon oil product.

[0009]

[Problem(s) to be Solved by the Invention] This invention possesses the suitable radical genuine article nature as lubricating oil base oil, and has a viscosity index high moreover enough. And by an aromatic series content's being lubricating oil base oil of the high performance which has ideal physical properties and description, such as excelling in stability (heat, light, oxidation, shear stability, etc.) etc. very low, and applying this as base oil Expansion of an application temperature requirement, improvement in stability and endurance, and the physical properties as a lubricating oil and optimization of the engine performance can be attained easily. Therefore, for example, various kinds of lubricating oils used for various kinds of industrial machines and equipments, such as automobiles, a vessel, or a machine for construction / machining, etc. The lubricating oil base oil of a low aromatic hydrocarbon system remarkable and practically, useful which can be advantageously used for (for example, **, such as engine oil, an ATF oil, and hydraulic oil) as base oil used as the principal component, It aims at offering the approach of obtaining comparatively the lubricating oil base oil of this high performance easily at low cost from heavy gas oil or a vacuum gas oil as the suitable manufacture approach.

[0010]

[Means for Solving the Problem] Heavy gas oil and the vacuum gas oil which are obtained from a variety of [this invention persons] crude oils After carrying out distillation separation of the hydrocracking oil by hydrocracking (stock oil may be called hereafter) according to a conventional method at a fuel oil fraction and a lubricating oil fraction and dewaxing the obtained lubricating oil fraction, under existence of a hydrogen-treating catalyst With the comparatively high reaction pressure, a reaction condition, i.e., 170-230kg/cm²G, severer than the conventional conditions And a hydrogen treating is carried out on condition that specification called the reaction temperature of 220-370 degrees C, and supply liquid-space-velocity (LHSV) 0.2-1.5hr-1. The specific hydrocarbon fraction in the range whose boiling point in the ordinary pressure collected from this generation oil according to distillation separation is 300-520 degrees C It has a viscosity index high enough, and moreover, the amount of aromatic series is fully few, it is excellent in the stability over heat, light, oxidation, etc., and it found out that it was very useful as base oil of the lubricating oil of the high performance which can be used suitable for various kinds of above-mentioned applications. In addition, when it, still more generally, examined in the detail what kind of physical properties the base oil would be expected based on the hydrocarbon fraction of low aromatic series obtained in this way for designing and preparing the lubricating oil of high performance, the conclusion that it was important that it is in the specific range with a boiling range, a total aromatic series content, kinematic viscosity, a viscosity index, the pour point, and oxidation stability (RBOT value) at least was reached.

[0011] That is, this invention persons checked that the approach of consisting of new technique of carrying out a hydrogen treating on condition that above specification as the manufacture approach of that this lubricating oil base oil that has such specific physical properties and description turns into outstanding lubricating oil base oil with which are satisfied of the above-mentioned purpose, and the lubricating oil base oil made into the purpose of such high performance was suitable, and is an advantageous approach on practical use.

[0012] Moreover, the inside of the fuel oil fraction which this invention persons got by distillation of the above-mentioned hydrocracking oil, and a lubricating oil fraction, By mixing, after distill a fuel oil fraction further, separating into a light fraction and a heavy fraction, dewaxing the heavy fraction with a lubricating oil fraction, performing the above-mentioned hydrogen treating or dewaxing separately, and performing the above-mentioned hydrogen treating It found out that lubricating oil base oil excellent in the stability from which viscosity grade differs with the lubricating oil base oil which was excellent in the above was obtained as a by-product.

[0013] this invention persons came to complete this invention based on these knowledge.

[0014] Namely, this invention is in the range whose boiling point in ** ordinary pressure it is lubricating oil base oil of a hydrocarbon system, and is 300-520 degrees C. ** Be in the range the amount of [whose] all aromatic series is 1.8 or less % of the weight and whose kinematic

viscosity in **40 degree 15–25mm²/s. ** A viscosity index is 100 or more and ** pour point is –10 degrees C or less. ** Offer the lubricating oil base oil characterized by the oxidation stability when adding 2 and 6-JITA challs butyl-p-cresol (DBPC) 0.5% of the weight being 410 minutes or more in a RBOT value.

[0015] moreover, this invention as the suitable manufacture approach of the lubricating oil base oil of above-mentioned this invention Heavy gas oil (HGO) and/or a vacuum gas oil (VGO) A silica alumina, It hydrocracks under existence of the hydrocracking catalyst which makes an alumina and/or a zeolite support and contains periodic-table 6 group's metal and/or eight to 10 group's (IUPAC 1991 periodic table) metal. Carry out distillation separation of the decomposition product concerned at a fuel oil fraction and a lubricating oil fraction, perform dewaxing processing by solvent dewaxing and/or hydrogenation dewaxing to the lubricating oil fraction concerned, and a part for a wax is removed from this fraction. Under existence of the hydrogenation catalyst which makes a silica alumina and/or an alumina support for the obtained dewaxing lubricating oil fraction, and contains periodic-table 6 group's metal and/or eight to 10 group's metal A hydrogen treating is carried out on condition that total pressure 170–230kg/cm²G, the reaction temperature of 220–370 degrees C, and supply liquid-space-velocity (LHSV) 0.2–1.5hr⁻¹. The approach characterized by carrying out separation recovery of the fraction which is in the range whose boiling point in ordinary pressure is 300–520 degrees C by distillation is collectively offered from this generation oil. In addition, this approach, i.e., the approach of this invention, may be called Approach A.

[0016] This invention as the suitable manufacture approach of the lubricating oil of above-mentioned this invention furthermore, heavy gas oil (HGO) and/or a vacuum gas oil (VGO) It hydrocracks under existence of the hydrocracking catalyst which makes a silica alumina, an alumina, and/or a zeolite support, and contains periodic-table 6 group's metal and/or eight to 10 group's metal. Carry out distillation separation of the decomposition product concerned at a fuel oil fraction and a lubricating oil fraction, and distillation separation of the fuel oil fraction concerned is carried out further at a light fraction and a heavy fraction. Dewaxing processing by solvent dewaxing and/or hydrogenation dewaxing is performed to a mixed fraction with a lubricating oil fraction and the heavy fraction concerned, a part for a wax is removed from this mixed fraction, and a dewaxing mixing fraction is obtained. Dewaxing processing by solvent dewaxing and/or hydrogenation dewaxing is performed to each of the lubricating oil fraction concerned and the heavy fraction concerned, a part for a wax is removed from each fraction, and a dewaxing lubricating oil fraction and a dewaxing heavy fraction are obtained. Subsequently Under existence of the hydrogenation catalyst which makes a silica alumina and/or an alumina support for the mixture of the dewaxing mixing fraction concerned or the dewaxing lubricating oil fraction concerned, and the dewaxing heavy fraction concerned, and contains periodic-table 6 group's metal and/or eight to 10 group's metal A hydrogen treating is carried out on condition that total pressure 170–230kg/cm²G, the reaction temperature of 220–370 degrees C, and supply liquid-space-velocity (LHSV) 0.2–1.5hr⁻¹. The approach characterized by carrying out separation recovery of the fraction which is in the range whose boiling point in ordinary pressure is 300–520 degrees C by distillation is collectively offered from this generation oil. In addition, this approach, i.e., the approach of this invention, may be called Approach B.

[0017]

[Embodiment of the Invention] Hereafter, the lubricating oil base oil of this invention is first explained to a detail.

[0018] Although it is realizable as a thing of various presentations or description according to the purpose and the manufacture approach, as for the lubricating oil base oil of this invention, it is important to have satisfied all the conditions of the aforementioned ** – ** at least.

[0019] That is, it is important for the lubricating oil base oil of this invention that it is in the range whose boiling point in ordinary pressure is 300–520 degrees C, and its fraction which is 330–510 degrees C is especially desirable. If the boiling point contains the fraction of a high-boiling point remarkably exceeding a less than 300-degree C low-boiling point fraction or 520 degrees C, the basic property as lubricating oil base oil may not fully be demonstrated, for example, an evaporation loss will increase or it will be easy to produce trouble, such as becoming

an increase of energy loss, viscous drag size, here. However, although various additives, such as an oxidation stability improver, are generally added usually according to the purpose in case various kinds of lubricating oils are prepared using this lubricating oil base oil, there is especially no limit about the additive added in that case, and the thing of the usual various boiling points may be added suitably.

[0020] Although it is hydrocarbon mixture which is the thing of a hydrocarbon system and generally uses saturated hydrocarbon, such as n-paraffin, a branched paraffin, and a naphthene hydrocarbon, as a principal component, though the lubricating oil base oil of this invention contains aromatic hydrocarbon, it is important also for the amount of all aromatic series being 1.8 or less % of the weight, and that [its] the amount of [whose] all aromatic series is 1.0 or less % of the weight especially is desirable. The value for all aromatic series here is measured by the approach of ASTM-D -2549 (following, the same). Thus, by making a total aromatic series content into the low value of 1.8 or less % of the weight, the stability over heat, light, oxidation, etc. is fully securable, it is fully stable and the lubricating oil excellent in endurance can be realized easily. Of course, you may use it for it, adding suitably various kinds of well-known stabilizer or well-known stabilization assistants, such as an oxidation stabilizer, etc. also in the case of the lubricating oil base oil of this invention, and raising stability and endurance to it further if needed.

[0021] Moreover, that it is in the range which is 15-25mm²/s also has the important kinematic viscosity in 40 degrees C, and, as for the lubricating oil base oil of this invention, what is in the range whose kinematic viscosity in 40 degrees C is 18-22mm²/s especially is desirable. That is, the lubricating oil base oil of this invention is characterized by having an above comparatively low kinematic viscosity property, and is hypoviscosity lubricating oil base oil of high performance.

[0022] Moreover, the lubricating oil base oil of this invention is important also for a viscosity index being 107 or more, and that [its] whose viscosity index is 110 or more especially is desirable. Since the viscosity index has the high value or more of 107 in this way, by applying this as base oil of a lubricating oil, the lubricating oil base oil of this invention can fully expand the application temperature requirement of the lubricating oil, and can attain multi-grade-ization of a lubricating oil suitably. Also in the case of the lubricating oil base oil of this invention, the additive for improving viscosity indexes, such as polymethacrylate, like the conventional thing can also be used, adding to it suitably, but in the case of this invention, since there may be few such additives than the conventional case, there is an advantage that the fall (for example, fall of shear stability) of the other physical properties and property which tend to be produced by addition of an additive can be controlled to the minimum. In addition, the lubricating oil base oil of this invention possesses high shear stability.

[0023] Furthermore, the lubricating oil base oil of this invention is important also for the pour point being -10.0 degrees C or less, and that [its] whose pour point is -15 degrees C or less especially is desirable. By this, the cold-temperature fluidity of a lubricating oil can be secured and it can fully respond also to the use in a low-temperature environment.

[0024] Moreover, although the lubricating oil base oil of this invention has the stability over heat sufficient also by itself, light, oxidation, etc., various kinds of stabilizers, stabilization assistants, etc., such as an oxidation stabilizer, can be added and used for it if needed. As this oxidation stabilizer etc., although various kinds of well-known things, such as the below-mentioned thing, are usable, it is important for the lubricating oil base oil of this invention that the oxidation stability when adding 2 and 6-JITA chalis butyl-p-cresol (DBPC) 0.5% of the weight is also 410 minutes or more in a RBOT value (in addition, a RBOT value is measured by ASTM-D -2272 in this case). Of course, this does not mean always adding and using DBPC, can show that oxidation stability high enough is very securable as mentioned above with addition of the oxidation stabilizer of a minute amount, and can add and use the oxidation stabilizer of arbitration at a rate of arbitration if needed.

[0025] If the lubricating oil base oil of this invention has satisfied the conditions of the above-mentioned ** - ** at least as mentioned above, although there is especially no limit about general physical properties, descriptions, etc. other than these, what is generally in the range

whose aniline point is 100 degrees C is desirable, and a thing 200 degrees C or more is desirable about the flash point, and, speaking of a hue, +20 or more things are desirable in for example, a Saybolt color.

[0026] As mentioned above, the lubricating oil base oil of this invention is excellent in the radical genuine article nature as lubricating oil base oil for preparing the lubricating oil of various kinds of high performance. It has a hyperviscous characteristic especially. Also in itself, the amount of aromatic series few enough Heat, It excels in the stability over light, oxidation, etc. also by addition of stabilizers, such as an oxidation stabilizer of a **** minute amount, heat, It is hypoviscosity lubricating oil base oil of the high performance which has the various advantages of fully being able to attain the further improvement in the stability over light, oxidation, etc. It can be used very advantageous as base oil for preparing the optimal lubricating oil for various kinds of applications by responding to the purpose, adjusting and optimizing the physical properties and description of ** - **, or selecting and adjusting other physical properties and descriptions suitably within the limits of the above.

[0027] In addition, it responds to the purpose, and various kinds of additives can be used for the lubricating oil base oil of this invention, mixing or adding to it. That is, although itself of the lubricating oil base oil of this invention is also usable as a lubricating oil, it is good to use it as a lubricating oil which added various kinds of additives according to the purpose, and suited each application so that it may generally usually be carried out.

[0028] As an additive, various kinds of things, such as a well-known thing, are usable. As this additive for example Phenol systems, such as 2 and 6-JITA challis butyl-p-cresol, Antioxidants, such as an amine system, a sulfur system, a thiophosphoric acid zinc system, and a phenothiazin system, Molybdenum dithiophosphate, a molybdenum dithio carbamate, molybdenum disulfide, Fluoride carbon, way acid ester, fatty amine, higher alcohol, Friction reduction agents, such as a higher fatty acid, fatty acid ester, and a fatty-acid amide, tricresyl phosphate, Extreme pressure agents, such as triphenyl phosphate and dithiophosphate zinc, petroleum sulfonate, Rust preventives, such as alkylbenzene sulfonate and dinonyl naphthalene sulfonate, Metal deactivators, such as benzotriazol, alkaline-earth-metal sulfonate, Metal system detergent, such as alkali earth metal phenate, an alkaline-earth-metal SARISHI rate, and alkaline-earth-metal phosphonate, viscosity index improvers, such as defoaming agents, such as silicone, polymethacrylate, a polyisobutylene, and polystyrene, a pour point depressant, etc. are mentioned, and independent in these -- or two or more sorts can be combined and it can add.

[0029] as the base oil of the lubricating oil of high performance to which the lubricating oil base oil of this invention suited said application of the various kinds carried out -- suitable -- use -- things are made.

[0030] As the general manufacture approach, although there is no lubricating oil base oil of this invention, it can manufacture especially a limit with suitably and sufficient productivity by the approach of said this invention. Moreover, as for the lubricating oil base oil of this invention, what was manufactured by this approach A especially is desirable.

[0031] Hereafter, the approach A of this invention which is the suitable manufacture approach of the lubricating oil base oil of this invention is explained to a detail.

[0032] In this approach A, heavy gas oil (HGO), a vacuum gas oil (VGO), or the mixed oil of the rate of such arbitration is used as stock oil. As this stock oil, the thing from various kinds of crude oils etc. is usable.

[0033] From this stock oil, target lubricating oil base oil is fundamentally manufactured according to the essential-oil process which consists of a hydrocracking process, a distillation process, a dewaxing (wax part removal) process, a hydrogen-treating (dearomatic series) process, and a distillation process, as shown below.

[0034] (Process A-1) hydrogenation part ** -- as stock oil with which this hydrocracking is presented, fundamentally, although said heavy gas oil (HGO), a vacuum gas oil (VGO), or the mixed oil of the rate of such arbitration is used, optimum dose addition of the recycle oil from a latter process may be carried out suitably, and a reaction may be presented at these if needed.

[0035] Hydrocracking is usually suitably carried out under the terms and conditions shown below.

[0036] That is, reaction pressure is total pressure and it is usually suitable for it preferably 100–190kg/cm²G and to select in the range of 130–180kg/cm²G.

[0037] 3 and 500–1500Nm of adjusting 800–1200Nm of rates of supply hydrogen gas to the range of 3 preferably to 1kl of supply oils are usually appropriate.

[0038] It is usually suitable for reaction temperature preferably to select [340–440-degree C] in the range of 350–420 degrees C.

[0039] moreover, liquid space velocity (LHSV) -- supply oil criteria -- it is -- usually -- 0.3–1.5hr⁻¹ -- what is necessary is just to adjust suitably in the range of 0.5–1.2hr⁻¹ preferably

[0040] The hydrocracking catalyst which makes a silica alumina, an alumina, and/or a zeolite support, and contains periodic-table 6 group's metal and/or eight to 10 group's metal as a catalyst used for this hydrocracking is used. Here, as a periodic-table 6 group metal, Cr, Mo, and W can be mentioned and Mo and W are usually desirable also in these. As a periodic table 8 – 10 group metals, although Fe, Co, nickel, Rh, Ru, Pd, Os, Ir, and Pt can be mentioned, nickel etc. is usually desirable. Although these metals can be used by the one-sort independent and can also be used combining two or more sorts according to a case, combination, such as nickel–Mo and nickel–W, is usually suitable for them. In addition, although various kinds of things, such as an X type, Y mold, and B mold, are usable when using a zeolite, Y mold etc. is used suitably even especially in inside. Moreover, the support of two or more classes may be used suitably, mixing or compounding. For example, in the case of a zeolite, what used the alumina, the silica alumina, etc. as a matrix and fabricated them to this is used suitably. Furthermore, as this catalyst, the thing containing support component metallurgy group components other than the above is also usable suitably.

[0041] (Process A-2) At the process of *****, distillation separates into a lubricating oil fraction, a fuel oil fraction, etc. the decomposition generation oil obtained by hydrocracking of the above-mentioned process A-1. As a lubricating oil fraction, it is good preferably the fraction of 250–540 degrees C of boiling ranges, and to carry out separation recovery of the fraction of 300–530 degrees C of boiling ranges, and, for that purpose, a fuel oil fraction is usually good in that case, to dissociate so that the terminal point of the boiling point may become 250–390 degrees C. In addition, the boiling point of ordinary pressure or ordinary pressure conversion has shown each boiling point (following, the same).

[0042] In this way, although the lubricating oil fraction in the separated predetermined boiling range is sent to the following process A-3 and dewaxing processing is presented with it, it may recycle this a part of lubricating oil fraction at the above-mentioned process A-1 if needed. On the other hand, fuel oil and recovery gas which were separated can be used effective in each application.

[0043] (Process A-3) At the process A-3 of *****, dewaxing processing of the lubricating oil fraction obtained at the above-mentioned process A-2 is carried out, and a part for a wax (a part for a wax) is fully removed. This dewaxing is performed with the hydrogenation dewaxing process (b) which hydrogenates using the following solvent dewaxing process (a) or following catalyst by solvent extraction. In addition, if needed, (b) may be combined with (a), and (b) may be suitably, carried out after (a) in that case, or (a) may be conversely performed after (b). However, the following (a) or (b) can usually perform sufficient dewaxing.

[0044] (a) MEK usually using a methyl ethyl ketone (MEK) as an extract solvent component although various kinds of well-known solvent dewaxing processes using various kinds of solvents as a solvent dewaxing process of ***** are applicable -- law is used suitably. Although dewaxing processing by this MEK method can be fundamentally performed according to a conventional method, it is usually suitable to carry out under the following terms and conditions.

[0045] namely, -- as a dewaxing solvent -- from MEK and toluene -- becoming -- MEK -- 30 to 70 capacity % -- desirable -- 35 to 50 capacity % -- it is -- this -- corresponding -- toluene -- 70 to 30 capacity % -- the thing of a presentation of 65 – 50 capacity % is used suitably preferably. In addition, the solvent which carried out optimum dose addition of other solvents other than MEK and toluene suitably may be used if needed.

[0046] supply of said lubricating oil fraction with which said dewaxing solvent and dewaxing processing are presented -- although there is especially no limit if it carries out comparatively --

-- usually -- a capacity factor (a supply solvent / supply lubricating oil fraction) -- 1.0-6.0 -- it is suitable although preferably dewaxed by selecting in the range of 1.5-4.5.

[0047] although there is especially no limit as temperature of dewaxing processing in that case -- the temperature of the solvent at the time of dewaxing -- usually -45- it is suitable to carry out -10 degrees C preferably, so that it may be held in the range of -40--15 degree C.

[0048] Extract removal of the part for a wax is carried out from said lubricating oil fraction as mentioned above, it dissociates with a solvent and the lubricating oil fractions which removed a part for a wax are collected. In addition, in order to fully remove a part for a wax, it is desirable to carry out so that it may usually become the range of 60 - 85 capacity % to the raw material lubricating oil fraction which the yield of a recovery lubricating oil fraction used.

[0049] (b) Dewax under existence of a suitable catalyst by the hydrogenation dewaxing this gentleman method by carrying out catalytic reaction of said lubricating oil fraction to hydrogen. Although this hydrogenation dewaxing can also be fundamentally performed according to a conventional method, it can usually make suitably by performing the hydrogenation reaction for dewaxing under the following terms and conditions.

[0050] As a catalyst, although various kinds of things are usable, the zeolite of ZSM-5 or ZSM-5 mold is usually used suitably.

[0051] It is usually appropriate 20-100kg/cm²G and to select the total pressure of a reaction in the range of 25-70kg/cm²G preferably.

[0052] It is usually suitable for reaction temperature preferably to select [230-360-degree C] in the range of 250-350 degrees C.

[0053] Liquid space velocity (LHSV) is supply oil (lubricating oil fraction) criteria, and it is usually appropriate for it preferably 0.3-3.0hr⁻¹ and to select in the range of 0.5-2.5hr⁻¹.

[0054] Vapor liquid separation of the product is carried out after a reaction, and the lubricating oil fractions by which the request was further dewaxed by performing after treatment, such as distillation or solvent extraction, if needed are collected. However, the method supplied to the following hydrogen-treating process as it is without carrying out vapor liquid separation of the product depending on the case may be adopted.

[0055] (Process A-4) Hydrogen treating (dearomatic series processing)

At this process A-4, the hydrogen treating of the dewaxing lubricating oil fraction obtained at the above-mentioned process A-3 is carried out under existence of a predetermined hydrogen-treating catalyst, and the purification lubricating oil fraction by which the aromatic compound contained in this raw material lubricating oil fraction was hydrogenated, and a part for aromatic series was reduced below at the predetermined value is obtained.

[0056] The hydrogenation catalyst which makes a silica alumina and/or an alumina support and contains periodic-table 6 group's metal and/or eight to 10 group's metal as a catalyst used for this hydrogen-treating reaction is used. Here, as a periodic-table 6 group metal, Cr, Mo, and W can be mentioned and Mo and W are usually desirable also in these. As a periodic table 8 - 10 group metals, although Fe, Co, nickel, Rh, Ru, Pd, Os, Ir, and Pt can be mentioned, nickel etc. is usually desirable. Although these metals can be used by the one-sort independent and can also be used combining two or more sorts according to a case, combination, such as nickel-Mo and nickel-W, is usually suitable for them. In addition, the support of two or more classes may be used suitably, mixing or compound-izing. What can apply various kinds of well-known things as this catalyst, and contains support component metallurgy group components other than the above is usable suitably.

[0057] It is characterized by performing the hydrogen treating for this dearomatic series under high pressure rather than the conventional case, and it is important to carry out under the following terms and conditions.

[0058] That is, as for this hydrogen treating, it is desirable to select reaction pressure in the range which it is important to be total pressure and to carry out by selecting in the range of 170-230kg/cm²G, and is 180-220kg/cm²G especially, and to carry out.

[0059] Here, since sufficient dearomatization is not made as reaction pressure (total pressure) is under 170kg/cm²G, the purpose of this invention cannot fully be attained. Since reaction pressure needs the special equipment which bears high pressure so much above 230kg/cm²G

and facility cost becomes high on the other hand, it is uneconomical.

[0060] Thus, sufficient dearomatic series becomes possible, without pretreating solvent refining by the furfural of a raw material lubricating oil fraction which was conventionally performed by reacting in the high-pressure range rather than a conventional method as mentioned above etc. (preceding paragraph dearomatic series processing). Therefore, by the approach of this invention, the part process is simplified and it becomes remarkably [that it is economical and] advantageous.

[0061] In addition, 3 and 250-1500Nm of adjusting 300-1200Nm of rates of the supply hydrogen gas in this hydrogen treating to the range of 3 preferably to 1kl of supply oils are usually appropriate.

[0062] As for reaction temperature, it is important to select in the range of 220-370 degrees C, and it is desirable to select especially in the range which is 230-360 degrees C. If it becomes insufficient [less than 220 degrees C] dearomatizing reaction temperature and it exceeds 370 degrees C on the other hand, it will become impossible to disregard side reaction, such as a hydrocracking reaction, the yield of a desired lubricating oil fraction will fall, and the disadvantage on a process will be caused.

[0063] moreover, this hydrogen-treating reaction -- liquid space velocity (LHSV) -- supply oil criteria -- it is -- 0.2-1.5hr⁻¹ -- preferably, it adjusts suitably in the range of 0.3-1.0hr⁻¹, and carries out in it. Less than [0.2hr⁻¹], productivity worsens, and on the other hand, if LHSV is larger than 1.5hr⁻¹, it cannot attain sufficient dearomatization.

[0064] The generation oil obtained by the hydrogen treating as mentioned above is sent to the following distillation process, and distillation separation is carried out.

[0065] (Process A-5) Distillation (recovery of low aromatic series lubricating oil base oil made into the purpose)

At this process A-5, the generation oil obtained by the hydrogen treating of the above-mentioned process A-4 is distilled, and the lubricating oil base oil (desirable mode of the lubricating oil base oil of this invention) made into the purpose is obtained.

[0066] Although this distillation can be performed according to a conventional method, a boiling range carries out separation recovery of the 300-520 degrees C of the lubricating oil base oil made into the purpose as a 330-510-degree C fraction preferably.

[0067] It is cheap, and according to the above process A-1 to A-5, from the low heavy gas oil of added value, a vacuum gas oil, or its mixture, it is efficient and, moreover, the lubricating oil base oil of the high performance which is the desirable mode of the lubricating oil base oil of this invention which satisfies the conditions of the aforementioned ** - ** can be manufactured with sufficient productivity by low cost.

[0068] In this way, the obtained lubricating oil base oil can be used in favor of various kinds of above mentioned applications.

[0069] Next, the approach B of this invention which are other suitable manufacture approaches of the lubricating oil base oil of this invention is explained to a detail.

[0070] The fuel oil fraction which obtained by distillation of the hydrocracking oil of stock oil in the above-mentioned approach A, and was obtained with the hydrocracking oil of stock oil in this approach B to manufacturing the lubricating oil base oil of this invention by performing and distilling the above-mentioned hydrogen treating only to a lubricating oil fraction is distilled further, it separates into a light fraction and a heavy fraction, that heavy fraction is used with a lubricating oil fraction, and the lubricating oil base oil of this invention is manufactured. According to this approach B, a part for heavy [in a fuel oil fraction] can be used effectively as a raw material of the lubricating oil base oil which was excellent in this invention, the lubricating oil base oil (lubricating oil base oil A may be called hereafter) and viscosity grade of this invention differ from each other, and lubricating oil base oil (lubricating oil base oil B may be called hereafter) excellent in stability is obtained as a by-product.

[0071] In this approach B, heavy gas oil (HGO), a vacuum gas oil (VGO), or the mixed oil of the rate of such arbitration is used as stock oil like Approach A. As this stock oil, the thing from various kinds of crude oils etc. is usable.

[0072] The refinery process of this approach B consists of the hydrocracking process, the

distillation process (distillation process ** and distillation process **), dewaxing (wax part removal) process, hydrogen-treating (dearomatic series) process, and distillation process of this stock oil fundamentally, as shown below.

[0073] (Process B-1) hydrogenation part ** -- the conditions of the stock oil with which this hydrocracking is presented, and hydrocracking are the same as the process A-1 Of Approach A.

[0074] (Process B-2) distillation distillation process ** -- in this distillation process **, distillation separates into a lubricating oil fraction, a fuel oil fraction, etc. the decomposition generation oil obtained by hydrocracking of the above-mentioned process B-1 like Approach A. Like Approach A, as a lubricating oil fraction, it is good preferably the fraction of 250-540 degrees C of boiling ranges, and to carry out separation recovery of the fraction of 300-530 degrees C of boiling ranges, and, for that purpose, it usually good [a fuel oil fraction] to dissociate so that the terminal point of the boiling point may become 250-390 degrees C.

[0075] In this way, a part of separated lubricating oil fraction may be recycled at the above-mentioned process B-1 like Approach A if needed. On the other hand, recovery gas can be used effective in each application.

[0076] distillation process ** -- in this distillation process **, the fuel oil fraction obtained by the above-mentioned distillation process ** is distilled further, and it separates into a light fraction and a heavy fraction. As a heavy fraction, it is good preferably the fraction of 240-390 degrees C of boiling ranges, and to carry out separation recovery of the fraction of 270-390 degrees C of boiling ranges, and, for that purpose, a light fraction is usually good in that case, to dissociate so that the terminal point of the boiling point may become 230-320 degrees C.

[0077] In this way, the separated light fraction can be used effective in the application as fuel oil etc.

[0078] (Process B-3) At the process B-3 of *****, dewaxing processing is performed to the mixed fraction of the lubricating oil fraction obtained by distillation process ** of the (1) above-mentioned process B-2, and the heavy fraction obtained by distillation process **, a dewaxing mixing fraction is obtained, or dewaxing processing is separately performed to each of the (2) above-mentioned lubricating oil fraction and the above-mentioned heavy fraction, and a dewaxing lubricating oil fraction and a dewaxing heavy fraction are obtained.

[0079] The above (1) and in the case of (2), this dewaxing is similarly performed [both] in the process A-3 of Approach A with the hydrogenation dewaxing process (b) which hydrogenates using the solvent dewaxing process (a) or catalyst by solvent extraction. In addition, if needed, (b) may be combined with (a), and (b) may be suitably, carried out after (a) in that case, or (a) may be conversely performed after (b). However, the following (a) or (b) can usually perform sufficient dewaxing.

[0080] The classes of the solvent dewaxing process suitably adopted in this process B-3 and hydrogenation dewaxing process, those conditions, etc. are the same also in the process A-3 of Approach A as they are shown below.

[0081] (a) The same thing is used with having explained solvent dewaxing in Approach A as a solvent used for solvent dewaxing solvent dewaxing.

[0082] In the supply rate of said mixed fraction with which said dewaxing solvent and dewaxing processing are presented, and a list, as a supply rate of said lubricating oil fraction and a heavy fraction usually, a capacity factor (a supply solvent / supply mixing fraction, a supply solvent / supply lubricating oil fraction, or a supply solvent / supply heavy fraction) -- 1.0-6.0 -- preferably although it is suitable although dewaxed by selecting in the range of 1.5-4.5, and there is especially no limit as temperature of dewaxing processing -- the temperature of the solvent at the time of dewaxing -- usually -45- it is suitable to carry out -10 degrees C preferably, so that it may be held in the range of -40--15 degree C.

[0083] the dewaxing mixing fraction which carried out extract removal of the part for a wax separately from each of said lubricating oil fraction and a heavy fraction from said mixed fraction as mentioned above, and removed a part for a wax -- or it dissociates with a solvent and each of a dewaxing lubricating oil fraction and a dewaxing heavy fraction is collected. In addition, in order to fully remove a part for a wax, it is desirable to carry out so that the yield of a recovery dewaxing mixing fraction, a recovery dewaxing lubricating oil fraction, or a recovery dewaxing

heavy fraction may usually become the range of 60 – 85 capacity % to used raw material mixing fraction, raw material lubricating oil fraction, or raw material heavy fraction.

[0084] (b) the bottom of existence of a catalyst suitable by the hydrogenation dewaxing this gentleman method -- said mixed fraction -- or dewax by carrying out catalytic reaction of said lubricating oil fraction and heavy fraction to hydrogen separately. Although this hydrogenation dewaxing can also be fundamentally performed according to a conventional method, it can usually make suitably by performing the hydrogenation reaction for dewaxing under the following terms and conditions.

[0085] As a catalyst, although various kinds of things are usable, the zeolite of ZSM-5 or ZSM-5 mold is usually used suitably.

[0086] It is usually appropriate 20-100kg/cm²G and to select the total pressure of a reaction in the range of 25-70kg/cm²G preferably.

[0087] It is usually suitable for reaction temperature preferably to select [230-360-degree C] in the range of 250-350 degrees C.

[0088] Liquid space velocity (LHSV) is supply oil (mixed fraction, lubricating oil fraction, or heavy fraction) criteria, and it is usually appropriate for it preferably 0.3-3.0hr⁻¹ and to select in the range of 0.5-2.5hr⁻¹.

[0089] Vapor liquid separation of the product is carried out after a reaction, and the dewaxing mixing fraction by which the request was further dewaxed by performing after treatment, such as distillation or solvent extraction, if needed or a dewaxing lubricating oil fraction, and dewaxing heavy fractions are collected. However, the method supplied to the following hydrogen-treating process as it is without carrying out vapor liquid separation of the product depending on the case may be adopted.

[0090] (Process B-4) Hydrogen treating (dearomatic series processing)

At this process B-4, the hydrogen treating of the mixture of the dewaxing mixing fraction obtained at the above-mentioned process B-3 or the dewaxing lubricating oil fraction concerned, and the dewaxing heavy fraction concerned is carried out under existence of a predetermined hydrogen-treating catalyst, and the purification fraction by which the aromatic compound contained in this raw material dewaxing mixing fraction or the mixture of a dewaxing lubricating oil fraction and a dewaxing heavy fraction was hydrogenated, and a part for aromatic series was reduced below at the predetermined value is obtained.

[0091] The catalyst used for this hydrogen-treating reaction and the conditions of a hydrogen treating are the same as the process A-4 in Approach A.

[0092] (Process B-5) Distillation (recovery of low aromatic series lubricating oil base oil A and the low aromatic series lubricating oil base oil B as a by-product made into the purpose)

At this process B-5, the generation oil obtained by the hydrogen treating of the above-mentioned process B-4 is distilled, and the lubricating oil base oil A (desirable mode of the lubricating oil base oil of this invention) made into the purpose and the lubricating oil base oil B as a by-product are obtained.

[0093] Although this distillation can be performed according to a conventional method, as for the lubricating oil base oil A with which are satisfied of above-mentioned condition ** made into the purpose - **, 300-520 degrees C of boiling ranges carry out separation recovery as a 330-510-degree C fraction preferably.

[0094] Moreover, in this distillation, when a boiling range separates preferably 250-430 degrees C of 260-420-degree C fractions, unlike lubricating oil base oil A, viscosity grade can collect the lubricating oil base oil B which has stability sufficient as lubricating oil base oil as a by-product.

[0095] This lubricating oil base oil B is in the range whose boiling point in (a) ordinary pressure it is lubricating oil base oil of a hydrocarbon system, and is 250-430 degrees C. (b) It is in the range the amount of [whose] all aromatic series is 1.8 or less % of the weight and whose kinematic viscosity in (c) 40 degree C is 5-10mm²/s. (d) A viscosity index is 95 or more, and (e) pour point is -10 degrees C or less, and the oxidation stability when adding 2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight is a thing for 340 minutes or more in a RBOT value.

[0096] That is, it is important for lubricating oil base oil B that it is in the range whose boiling point in ordinary pressure is 250-430 degrees C, and its fraction which is 260-420 degrees C is

especially desirable.

[0097] It is the thing of a hydrocarbon system, generally, lubricating oil base oil B is hydrocarbon mixture which uses saturated hydrocarbon, such as n-paraffin, a branched paraffin, and a naphthene hydrocarbon, as a principal component, it is important for it that the amount of all aromatic series is 1.8 or less % of the weight though aromatic hydrocarbon is contained, and that [its] the amount of [whose] all aromatic series is 1.2 or less % of the weight especially is desirable.

[0098] Moreover, as for lubricating oil base oil B, what is in the range whose kinematic viscosity in 40 degrees C is 5-10mm²/s, and is in the range whose kinematic viscosity in 40 degrees C is 6-9mm²/s especially is desirable. That is, lubricating oil base oil B is characterized by having a kinematic viscosity property [as mentioned above] lower than the lubricating oil base oil of this invention, and is hypoviscosity lubricating oil base oil of high performance.

[0099] Moreover, a viscosity index is 95 or more and lubricating oil base oil B has that desirable whose viscosity index is 98 or more especially. Since the viscosity index has the comparatively high value or more of 95 in this way, by applying this as base oil of a lubricating oil, lubricating oil base oil B can fully expand the application temperature requirement of the lubricating oil, and can attain multi-grade-ization of a lubricating oil suitably. Also in the case of this lubricating oil base oil B, the additive for improving viscosity indexes, such as polymethacrylate, like the conventional thing can also be used, adding to it suitably, but in the case of this lubricating oil base oil B, since there may be few such additives than the conventional case, there is an advantage that the fall (for example, fall of shear stability) of the other physical properties and property which tend to be produced by addition of an additive can be controlled to the minimum. In addition, this lubricating oil base oil B possesses high shear stability.

[0100] Furthermore, lubricating oil base oil B is important also for the pour point being -10.0 degrees C or less, and that [its] whose pour point is -15 degrees C or less especially is desirable. By this, the cold-temperature fluidity of a lubricating oil can be secured and it can fully respond also to the use in a low-temperature environment.

[0101] Moreover, although lubricating oil base oil B has the stability over heat, light, oxidation, etc. also in itself, it can add and use various kinds of stabilizers, stabilization assistants, etc., such as an oxidation stabilizer, if needed. As this oxidation stabilizer etc., various kinds of well-known things, such as what was indicated previously, are usable. In addition, this lubricating oil base oil B has the description that the oxidation stability when adding 2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight is 340 minutes or more in a RBOT value.

[0102] Generally it is in the range whose aniline point is 95-110 degrees C, and the flash point is 150 degrees C or more, and, speaking of a hue, the lubricating oil base oil B obtained in the approach B of this invention is +20 or more things for example, in a Saybolt color.

[0103] As mentioned above, the lubricating oil base oil B obtained as a by-product in Approach B It has a comparatively high viscosity index. Also in itself, the amount of aromatic series few enough Heat, It excels in the stability over light, oxidation, etc. by addition of stabilizers, such as an oxidation stabilizer of a **** minute amount, heat, By being the outstanding hypoviscosity lubricating oil base oil which has the various advantages of fully being able to attain the further improvement in the stability over light, oxidation, etc., responding to the purpose, and adjusting and optimizing physical properties and description with the above-mentioned additive etc. It can be used very advantageous as base oil for preparing the optimal lubricating oil for various kinds of applications.

[0104] Are cheap by the above process B-1 to B-5. Namely, from the low heavy gas oil of added value, a vacuum gas oil, or its mixture While it is efficient and being able to manufacture the lubricating oil base oil A of the high performance which is the desirable mode of the lubricating oil base oil of this invention which satisfies the conditions of the aforementioned ** - ** with sufficient productivity moreover by low cost Viscosity grade can obtain the lubricating oil base oil B which shows the stability which was excellent similarly to heat, light, and oxidation unlike lubricating oil base oil A as a by-product.

[0105]

[Example] Although the example and its example of a comparison of this invention are shown

below and this invention is explained to it still more concretely, this invention is not limited to this example.

[0106] Hydrocracking was performed by total pressure 160kg/cm²G, the reaction temperature of 380 degrees C, LHSV1.0h⁻¹, and hydrogen / oil ratio 1000Nm³/kl under existence of the catalyst system which contains nickel and molybdenum in alumina support, and the catalyst system which contains nickel and molybdenum in an alumina +Y mold zeolite, using the heavy gas oil and the mixed oil of a vacuum gas oil which are shown in example 1 table 1 as stock oil.

[0107] 60 % of the weight (the terminal point of the boiling point is 370 degrees C) of fuel oil fractions and 40 % of the weight (320-530 degrees C of boiling ranges) of lubricating oil fractions were obtained with atmospheric distillation in the decomposition generation oil, respectively.

[0108] next -- a lubricating oil fraction -- MEK / toluene (capacity factors 5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of -27.5 degrees C. Dewaxing yield was 72 capacity %.

[0109] The viscosity index of the kinematic viscosity of this dewaxed oil was 118 in 24.2mm²/s (@40 degree C). The pour point at this time was -17.5 degrees C.

[0110] Next, the hydrogen treating was performed using the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil by the reaction temperature of 290 degrees C, total pressure 210kg/cm²G, LHSV0.5h⁻¹, and hydrogen / oil ratio 360Nm³/kl.

[0111] Subsequently, the lubricating oil base oil of 330-510 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation. The yield of this lubricating oil base oil was 76 % of the weight to dewaxed oil.

[0112] As shown in Table 2, the amount of aromatic series is as low as 0.46wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is as long as 436 minutes, and the heat instability test is passed further easily. Moreover, the pour point of the viscosity index at this time was -17.5 degrees C in 118.

[0113] Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily.

[0114] It carried out on the process and conditions as an example 1 with same example of comparison 1 hydrocracking, distillation, and dewaxing, and reaction temperature of hydrogen-treating conditions was carried out at 290 degrees C, the hydrogen treating of the total pressure was carried out by 160kg/cm²G, LHSV0.5h⁻¹, and hydrogen / oil ratio 360Nm³/kl, and, subsequently the lubricating oil base oil of 330-510 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation.

[0115] As shown in Table 2, the amount of aromatic series is 3.7wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is 405 minutes, and the heat instability test passes. Moreover, kinematic viscosity was 20.5mm²/s (@40 degree C), and the pour point of the viscosity index at this time was -17.5 degrees C in 118. The weathering test became a rejection.

[0116] It carried out on the process and conditions as an example 1 with same example of comparison 2 hydrocracking, distillation, and dewaxing, and, subsequently to 330-510 degrees-C fraction of boiling ranges, dissociated by distillation, furfural solvent refining of this fraction was carried out, and lubricating oil base oil was obtained.

[0117] As this base oil was shown in Table 2, the amount of aromatic series was as high as 6.6wt (s)%, and oxidation stability (RBOT@ additive 0.5wt% addition) was also 358 minutes. The weathering test became a rejection like the example 1 of a comparison.

[0118]

[Table 1]

原料油	重質軽油	減圧軽油
密度、g/cm ³ @15℃	0.879	0.913
動粘度、mm ² /s@50℃	10.5	29.9
硫黄分、wt %	1.0	2.0
窒素分、wt ppm	350	700
蒸留性状、℃ ASTM D2887		
IBP	239	261
10 %	344	376
30 %	378	432
50 %	396	465
70 %	417	493
90 %	445	526
EP	506	561

[0119]

[Table 2]

原 料	実施例 1		
	HGO/VGO	比較例 1	比較例 2
原料比率	5/5	5/5	5/5
水素化分解			
全圧力 kg/cm ²	160	160	160
LHSV h ⁻¹	1.0	1.0	1.0
温度 ℃	380	380	380
溶剤脱ろう			
溶剤/油 vol比	3	3	3
温度 ℃	- 28	- 28	- 28
水素化			
全圧力 kg/cm ²	210	160	-
LHSV h ⁻¹	0.5	0.5	-
溶剤脱芳香族(7475-4)			
溶剤/油 vol比	-	-	2.0
温度 ℃	-	-	110
動粘度 mm ² /s(@40℃)	20.5	20.1	20.2
粘度指数	118	118	118
組 成			
芳香族分 wt %	0.46	3.7	6.6
安 定 性			
熱安定性試験*1)			
判定	合格	合格	合格
酸化安定性試験*2)(min)	436	405	358
耐候性試験			
判定	合格 (○)	不合格 (△)	不合格 (×)

*1) JIS K It is based on 2540 (evaluation 12 hours after 170 degree-Cx).

*2) ASTM D It is based on 2272 (additive 0.5wt% addition).

*3) Evaluation 96 hours after being based on the photodegradation accelerated test equipment indicated by JP,1-94241,A. O showed by considering the case where the sample oil after examining all is transparence as success, and when it was alike to that extent, there was cloudiness more and there were ** and precipitate, x showed the rejection.

[0120] Hydrocracking was performed by total pressure 160kg/cm²G, the reaction temperature of 380 degrees C, LHSV1.0h⁻¹, and hydrogen / oil ratio 1000Nm³/kl under existence of the catalyst system which contains nickel and molybdenum in alumina support, and the catalyst system which contains nickel and molybdenum in an alumina +Y mold zeolite, using the heavy gas oil and the mixed oil of a vacuum gas oil which are shown in example 2 table 1 as stock oil.

[0121] By carrying out atmospheric distillation of the decomposition generation oil, 60 % of the weight (the terminal point of the boiling point is 390 degrees C) of fuel oil fractions and 40 % of the weight (320-530 degrees C of boiling ranges) of lubricating oil fractions were obtained, respectively.

[0122] Next, 60 % of the weight (the terminal point of the boiling point is 310 degrees C) of light fractions and 40 % of the weight (270-380 degrees C of boiling ranges) of heavy fractions were obtained by carrying out atmospheric distillation of the fuel oil fraction further, respectively.

[0123] next, lubricating oil fraction 65 capacity % and heavy fraction 35 capacity % of the fuel oil fraction separated by distillation -- mixing -- this mixed fraction -- MEK / toluene (capacity factors 5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of -30 degrees C. Dewaxing yield was 78 capacity %.

[0124] The viscosity index of the kinematic viscosity of this dewaxed oil was 113 in 14.6mm²/s (@40 degree C). The pour point at this time was -22.5 degrees C.

[0125] Next, the hydrogen treating was performed using the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil by the reaction temperature of 290 degrees C, total pressure 210kg/cm²G, LHSV0.5h⁻¹, and hydrogen / oil ratio 360Nm³/kl.

[0126] Subsequently, the lubricating oil base oil A of 374-502 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation. The yield of this lubricating oil base oil A was 66 % of the weight to dewaxed oil.

[0127] As shown in Table 4, the amount of [of lubricating oil base oil A] aromatic series is as low as 0.55wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is as long as 432 minutes, and the heat instability test is passed further easily. Moreover, kinematic viscosity was 20.9mm²/s (@40 degree C), and the pour point of the viscosity index at this time was -22.5 degrees C in 116. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily.

[0128] Moreover, the lubricating oil base oil B of 350-380 degrees-C fraction of boiling ranges was obtained to coincidence at the time of this distillation. The yield of this lubricating oil base oil B was 7 % of the weight to dewaxed oil.

[0129] As shown in Table 4, the amount of [of lubricating oil base oil B] aromatic series is as low as 0.75wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is as long as 415 minutes, and the heat instability test is passed further easily. Moreover, kinematic viscosity was 8.11mm²/s (@40 degree C), and the pour point of the viscosity index at this time was -25 degrees C in 100. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily.

[0130] The process which divides the generation oil from hydrocracking of example 3 stock oil and hydrocracking into a fuel oil fraction and a lubricating oil fraction with atmospheric distillation, and the process which divides a fuel oil fraction into a light fraction and a heavy fraction with atmospheric distillation were performed like the example 2.

[0131] next, lubricating oil fraction 75 capacity % and heavy fraction 25 capacity % of the fuel oil fraction separated by distillation -- mixing -- this mixed fraction -- MEK / toluene (capacity factors 5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of -30 degrees C. Dewaxing yield was 76 capacity %.

[0132] The viscosity index of the kinematic viscosity of this dewaxed oil was 115 in 16.7mm²/s (@40 degree C). The pour point at this time was -22.5 degrees C.

[0133] Next, the hydrogen treating was performed using the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil by the reaction temperature of 290 degrees C, total pressure 210kg/cm²G, LHSV0.5h⁻¹, and hydrogen / oil ratio 360Nm³/kl.

[0134] Subsequently, the lubricating oil base oil A of 385–495 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation. The yield of this lubricating oil base oil A was 72 % of the weight to dewaxed oil.

[0135] As shown in Table 4, the amount of [of lubricating oil base oil A] aromatic series is as low as 0.75wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is as long as 429 minutes, and the heat instability test is passed further easily. Moreover, kinematic viscosity was 20.8mm²/s (@40 degree C), and the pour point of the viscosity index at this time was –22.5 degrees C in 118. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily.

[0136] Moreover, the lubricating oil base oil B of 360–385 degrees-C fraction of boiling ranges was obtained to coincidence at the time of this distillation. The yield of this lubricating oil base oil B was 5 % of the weight to dewaxed oil.

[0137] As shown in Table 4, the amount of [of lubricating oil base oil B] aromatic series is as low as 0.95wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is as long as 380 minutes, and the heat instability test is passed further easily. Moreover, kinematic viscosity was 8.10mm²/s (@40 degree C), and the pour point of the viscosity index at this time was –25 degrees C in 108. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily.

[0138] The process which divides the generation oil from hydrocracking of example of comparison 3 stock oil and hydrocracking into a fuel oil fraction and a lubricating oil fraction with atmospheric distillation, and the process which divides a fuel oil fraction into a light fraction and a heavy fraction with atmospheric distillation were performed like the example 2.

[0139] Subsequently, reaction temperature of hydrogen-treating conditions was carried out at 290 degrees C, the hydrogen treating of the total pressure was carried out by 160kg/cm²G, LHSV0.5h–1, and hydrogen / oil ratio 360Nm³/kl, and, subsequently the lubricating oil base oil of 370–505 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation.

[0140] As shown in Table 5, the amount of aromatic series is 3.5wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is 407 minutes, and the heat instability test passes. Moreover, the pour point of the viscosity index at this time was –22.5 degrees C in 115. The weathering test became a rejection.

[0141] The process which divides the generation oil from hydrocracking of example of comparison 4 stock oil and hydrocracking into a fuel oil fraction and a lubricating oil fraction with atmospheric distillation, and the process which divides a fuel oil fraction into a light fraction and a heavy fraction with atmospheric distillation were performed like the example 2.

[0142] Subsequently, the obtained dewaxed oil was divided into 377–500 degrees-C fraction of boiling ranges by distillation, furfural solvent refining of this fraction was carried out, and lubricating oil base oil was obtained. The yield (rate of furfural extraction) of this base oil was 74 % of the weight.

[0143] As shown in Table 5, this base oil has the amount of aromatic series as high as 6.3wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is also 360 minutes, and the heat instability test passes. Moreover, the viscosity index was 115 and the pour point at this time was –22.5 degrees C. The weathering test became a rejection like the example 3 of a comparison.

[0144]

[Table 3]

原 料	実施例2		実施例3	
	HGO/VGO		HGO/VGO	
原料比率	5/5		5/5	
水素化分解				
全圧力 kg/cm ²	160		160	
LHSV h ⁻¹	1.0		1.0	
温度 °C	380		380	
水素/油比 Nm ³ /kl	1000		1000	
溶剤脱ろう				
溶剤/油 vol比	3		3	
温度 °C	- 30		- 30	
水素化				
温度 °C	290		290	
全圧力 Kg/cm ²	210		210	
LHSV h ⁻¹	0.5		0.5	
水素/油比 Nm ³ /kl	360		360	
溶剤脱芳香族(フルフラール)				
溶剤/油 vol比	-		-	
温度 °C	-		-	
潤滑油基油	A	B	A	B
動粘度 mm ² /s(@40°C)	20.9	8.11	20.8	8.10
粘度指数	116	100	118	108
流動点 °C	- 22.5	- 25.0	- 22.5	- 25.0
引火点 °C	220	195	221	196
アニリン点 °C	114.2	101.8	114.0	101.3
組 成				
芳香族分 wt %	0.55	0.75	0.75	0.95
安 定 性				
熱安定性試験*1)				
判定	合格	合格	合格	合格
酸化安定性試験*2) (min)	432	415	429	380
耐候性試験				
判定	合格 (○)	合格 (○)	合格 (○)	合格 (○)

[0145]

[Table 4]

原 料		比較例 3	比較例 4
		HGO/VGO	HGO/VGO
原料比率		5/5	5/5
水素化分解			
全圧力	kg/cm ²	160	160
LHSV	h ⁻¹	1.0	1.0
温度	℃	380	380
分解率	wt %	55	55
溶剤脱ろう			
溶剤／油	vol 比	3	3
温度	℃	- 30	- 30
水素化			
温度	℃	290	-
全圧力	Kg/cm ²	160	-
LHSV	h ⁻¹	0.5	-
水素／油比	Nm ³ /kl	360	-
溶剤脱芳香族(フルフラー)			
溶剤／油	vol 比	-	2.0
温度	℃	-	110
潤 滑 油 基 油		A	A
動粘度	mm ² /s(@40℃)	20.7	20.8
粘度指数		115	115
流動点	℃	- 22.5	- 22.5
引火点	℃	220	212
アニリン点	℃	113.9	113.3
組 成			
芳香族分	wt %	3.5	6.3
安 定 性			
熱安定性試験*1)			
判定		合格	合格
酸化安定性試験*2) (min)		407	360
耐候性試験			
判定		不合格 (△)	不合格 (×)

*1) JIS K It is based on 2540 (evaluation 12 hours after 170 degree-Cx).

*2) ASTM D It is based on 2272 (additive 0.5wt% addition).

*3) Evaluation 96 hours after being based on the photodegradation accelerated test equipment indicated by JP,1-94241,A. O showed by considering the case where the sample oil after examining all is transperence as success, and when it was alike to that extent, there was cloudiness more and there were ** and precipitate, x showed the rejection.

[0146]

[Effect of the Invention] According to this invention, provide the suitable radical genuine article nature as lubricating oil base oil, and it has a viscosity index high moreover enough. And by an aromatic series content's being highly efficient lubricating oil base oil which has ideal physical properties and description, such as excelling in stability (heat, light, oxidation, shear stability, etc.) etc. very low, and applying this as base oil Expansion of an application temperature requirement, improvement in stability and endurance, and the physical properties as various lubricating oils and optimization of the engine performance can be attained easily. Therefore, for example, various kinds of lubricating oils used for various kinds of industrial machines and equipments, such as automobiles, a vessel, or a machine for construction / machining, etc. for the various purpose The practically remarkable lubricating oil base oil of a useful low aromatic hydrocarbon system which can be advantageously used for (for example, **, such as engine oil, an ATF oil, and hydraulic oil) as base oil used as the principal component can be offered.

[0147] Moreover, according to this invention, it is cheap, and an approach for description to be efficient from the bad low heavy gas oil of added value, a vacuum gas oil, or its mixture, and manufacture the highly efficient lubricating oil base oil of above-mentioned this invention with sufficient productivity moreover by low cost can be offered, and the industrial value is very large.

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TECHNICAL FIELD

[Field of the Invention] This invention For example, the automobiles and vessels by the gasoline engine, a diesel power plant, etc., or various kinds of lubricating oils (engine oil —) used for various kinds of industrial machines and equipments, such as a machine for construction / machining, etc. for the various purpose If it says in more detail about the lubricating oil base oil advantageously used for **, such as an ATF oil and various hydraulic oil, as base oil used as the principal component, and its manufacture approach Since it has a hyperviscous characteristic and the aromatic series content has the ideal physical properties and ideal engine performance as lubricating oil base oil, such as excelling in stability (heat, light, oxidation, shear stability, etc.) etc. very low By applying this as base oil, expansion of an application temperature requirement, improvement in stability and endurance, The physical properties as various lubricating oils and optimization of the engine performance can be attained easily, and it is related with the lubricating oil base oil and its suitable manufacture approach of the hydrocarbon system which can prepare easily the lubricating oil of the high performance which can be used in favor of the above-mentioned application.

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PRIOR ART

[Description of the Prior Art] In recent years, high-performance-izing of an automobile, an industrial machine, etc. and-izing corresponding to energy saving progress, and improvement in the engine performance of the lubricating oil used for them is called for strongly. The engine performance of a lubricating oil has the large place depended on the quality of the base oil used as the principal component, i.e., lubricating oil base oil, especially, in the lubricating oils for automobiles (engine oil, an ATF oil, hydraulic oil, etc.), the hydraulic oil of the machinery for construction / machining, etc., it excels in the stability over improvement in shear stability, expansion of an application temperature requirement, oxidation, heat, light, etc., and, moreover, lubricating oil base oil of the hydrocarbon system of hypoviscosity high performance is desired moderately.

[0003] In addition, as a cure of expansion of an application temperature requirement, it is desirable to make high the viscosity index of lubricating oil base oil, and let it be a good plan to make especially the improvement or the reservation of stability to oxidation, heat, light, etc. reduce an aromatic series content.

[0004] From the former, it was used widely, the approach, i.e., the solvent refining process, by solvent extraction, and if manufacturing the lubricating oil base oil of a hyperviscous characteristic according to this solvent refining process was also performed for many years, it came for manufacture of the lubricating oil base oil of a hydrocarbon system, or adjustment of physical properties. however, in manufacturing the lubricating oil base oil of a hyperviscous characteristic according to such a solvent refining process Since it generally is not easy to raise the viscosity index of a lubricating oil fraction greatly by solvent refining The class of a crude oil itself will be limited narrowly, and moreover, even if strict in the extraction condition, since an improvement and control of oxidation stability etc. of other physical properties were also difficult, fully attaining hyperviscous indexation had easily, the trouble of receiving a limit strong against the physical properties and application of a product.

[0005] Then, as a means to manufacture the lubricating oil base oil of a hyperviscous characteristic, the approach of combining a solvent refining process and/or hydrotreating, and dewaxing processing with hydrocracking is proposed, and the attempt which is going to raise hyperviscous indexation and coincidence also as for the stability over heat, oxidation, etc. is comparatively made recently by reducing or controlling a part for aromatic series by solvent refining and/or the hydrogen treating in that case (refer to JP,3-223393,A, a 4-36391 official report, a 6-116571 official report, and a 6-116572 official report). Thus, with improvement in a viscosity index, the technical thought which is going to aim at improvement in stability by low aromatization deserves attention.

[0006] However, since it is hard to reduce an aromatic series content efficiently in any case, even if satisfied with an approach given in the above-mentioned official report of hyperviscous indexation, there will be a trouble that the reservation of stability to oxidation, heat, light, etc. is not easy. In above-mentioned JP,4-36391,A etc. although [dearomatic series processing / hydrotreating / the solvent refining process] it is desirable, since the rate of dearomatic series is low, in the lubricating oil base oil obtained, a part for the high-concentration aromatic series of 2 - 15 % of the weight is actually contained also by the solvent refining process. In such

lubricating oil base oil of a aromatic series content, the stability over sufficient oxidation, heat, light, etc. is not expectable. Moreover, although it is also expectable to raise the rate of dearomatic series so much if a solvent refining process and hydrotreating are combined better, the process for dearomatic series becomes complicated in that case, and an installed cost and a manufacturing cost become high. In addition, although improvement in the stability by dearomatic series is tried in JP,6-116571,A and a 6-116572 official report combining hydrotreating after the solvent refining process, sufficient improvement effect is not acquired like the above in fact.

[0007] On the other hand, the method of obtaining the low aromatic hydrocarbon oil which gives two steps of hydrotreating to a hydrocracking oil using the hydrogen-treating catalyst used regularly, and has lightfastness to it is indicated by JP,6-116570,A. By this approach, the 1st step of hydrogen treating is performed on condition that the reaction temperature of 290-355 degrees C, and the reaction pressure G of 50-150kg/cm², a part for aromatic series is reduced to 1 or less % of the weight, the 2nd step of hydrogen treating is performed on condition that the reaction temperature of 120-280 degrees C, and the reaction pressure G of 50-150kg/cm², and lightfastness is raised. It attracts attention apparently that a part for aromatic series can be reduced to 1 or less % of the weight by the hydrogen treating in such mild conditions. however, the example of this official report sees in this case -- as -- actual -- as the stock oil of the 1st step of hydrogen treating -- a hydrocracking oil -- MEK (methyl ethyl ketone) -- after performing dewaxing processing by law, it should be cautious of using what performed solvent-refining processing by the furfural further. Therefore, it is exactly the technique which combined a specific solvent refining process and specific hydrotreating like the above-mentioned technique after all also in this case. Namely, although the 1st step of hydrogen treating was performed in the example on the comparatively mild conditions of reaction pressure 80kg/cm²G and LHSV0.2hr⁻¹ and the amount of aromatic series has obtained the generation oil of the low value of 0.5 % of the weight by this approach This is because the good stock oil of the very specific description which performed dearomatic series processing by solvent refining special as mentioned above is used. After performing only dewaxing processing, without performing such specific pretreatment (solvent-refining processing by a furfural etc.) to stock oil, when a hydrogen treating is presented on the above mild conditions Generally it is very difficult to reduce a part for aromatic series to the low value of 0.5 % of the weight by one step of hydrogen treating.

[0008] Moreover, although the manufacture approach of a low aromatic hydrocarbon oil of having the target lightfastness in JP,6-116570,A is stated to the detail As an application of this hydrocarbon oil, the chief aim is set to the solvent for cleaning, the coating, the insecticide, or the solvent for ink. About a lubricating oil There is [that the boiling point (fraction 320 degrees C or more) of the stock oil with which hydrocracking is presented is only indicated, and] no explanation in any way in others, and nothing is actually indicated about the physical properties and engine performance as the lubricating oil base oil or the lubricating oil of this hydrocarbon oil product.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, provide the suitable radical genuine article nature as lubricating oil base oil, and it has a viscosity index high moreover enough. And by an aromatic series content's being highly efficient lubricating oil base oil which has ideal physical properties and description, such as excelling in stability (heat, light, oxidation, shear stability, etc.) etc. very low, and applying this as base oil Expansion of an application temperature requirement, improvement in stability and endurance, and the physical properties as various lubricating oils and optimization of the engine performance can be attained easily. Therefore, for example, various kinds of lubricating oils used for various kinds of industrial machines and equipments, such as automobiles, a vessel, or a machine for construction / machining, etc. for the various purpose The practically remarkable lubricating oil base oil of a useful low aromatic hydrocarbon system which can be advantageously used for (for example, **, such as engine oil, an ATF oil, and hydraulic oil) as base oil used as the principal component can be offered.

[0147] Moreover, according to this invention, it is cheap, and an approach for description to be efficient from the bad low heavy gas oil of added value, a vacuum gas oil, or its mixture, and manufacture the highly efficient lubricating oil base oil of above-mentioned this invention with sufficient productivity moreover by low cost can be offered, and the industrial value is very large.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] This invention possesses the suitable radical genuine article nature as lubricating oil base oil, and has a viscosity index high moreover enough. And by an aromatic series content's being lubricating oil base oil of the high performance which has ideal physical properties and description, such as excelling in stability (heat, light, oxidation, shear stability, etc.) etc. very low, and applying this as base oil Expansion of an application temperature requirement, improvement in stability and endurance, and the physical properties as a lubricating oil and optimization of the engine performance can be attained easily. Therefore, for example, various kinds of lubricating oils used for various kinds of industrial machines and equipments, such as automobiles, a vessel, or a machine for construction / machining, etc. The lubricating oil base oil of a low aromatic hydrocarbon system remarkable and practically, useful which can be advantageously used for (for example, **, such as engine oil, an ATF oil, and hydraulic oil) as base oil used as the principal component. It aims at offering the approach of obtaining comparatively the lubricating oil base oil of this high performance easily at low cost from heavy gas oil or a vacuum gas oil as the suitable manufacture approach.

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MEANS

[Means for Solving the Problem] Heavy gas oil and the vacuum gas oil which are obtained from a variety of [this invention persons] crude oils After carrying out distillation separation of the hydrocracking oil by hydrocracking (stock oil may be called hereafter) according to a conventional method at a fuel oil fraction and a lubricating oil fraction and dewaxing the obtained lubricating oil fraction, under existence of a hydrogen-treating catalyst With the comparatively high reaction pressure, a reaction condition, i.e., 170-230kg/cm²G, severer than the conventional conditions And a hydrogen treating is carried out on condition that specification called the reaction temperature of 220-370 degrees C, and supply liquid-space-velocity (LHSV) 0.2-1.5hr⁻¹. The specific hydrocarbon fraction in the range whose boiling point in the ordinary pressure collected from this generation oil according to distillation separation is 300-520 degrees C It has a viscosity index high enough, and moreover, the amount of aromatic series is fully few, it is excellent in the stability over heat, light, oxidation, etc., and it found out that it was very useful as base oil of the lubricating oil of the high performance which can be used suitable for various kinds of above-mentioned applications. In addition, when it, still more generally, examined in the detail what kind of physical properties the base oil would be expected based on the hydrocarbon fraction of low aromatic series obtained in this way for designing and preparing the lubricating oil of high performance, the conclusion that it was important that it is in the specific range with a boiling range, a total aromatic series content, kinematic viscosity, a viscosity index, the pour point, and oxidation stability (RBOT value) at least was reached.

[0011] That is, this invention persons checked that the approach of consisting of new technique of carrying out a hydrogen treating on condition that above specification as the manufacture approach of that this lubricating oil base oil that has such specific physical properties and description turns into outstanding lubricating oil base oil with which are satisfied of the above-mentioned purpose, and the lubricating oil base oil made into the purpose of such high performance was suitable, and is an advantageous approach on practical use.

[0012] Moreover, the inside of the fuel oil fraction which this invention persons got by distillation of the above-mentioned hydrocracking oil, and a lubricating oil fraction, By mixing, after distill a fuel oil fraction further, separating into a light fraction and a heavy fraction, dewaxing the heavy fraction with a lubricating oil fraction, performing the above-mentioned hydrogen treating or dewaxing separately, and performing the above-mentioned hydrogen treating It found out that lubricating oil base oil excellent in the stability from which viscosity grade differs with the lubricating oil base oil which was excellent in the above was obtained as a by-product.

[0013] this invention persons came to complete this invention based on these knowledge.

[0014] Namely, this invention is in the range whose boiling point in ** ordinary pressure it is lubricating oil base oil of a hydrocarbon system, and is 300-520 degrees C. ** Be in the range the amount of [whose] all aromatic series is 1.8 or less % of the weight and whose kinematic viscosity in **40 degree C is 15-25mm²/s. ** A viscosity index is 107 or more and ** pour point is -10 degrees C or less. ** Offer the lubricating oil base oil characterized by the oxidation stability when adding 2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight being 410 minutes or more in a RBOT value.

[0015] moreover, this invention as the suitable manufacture approach of the lubricating oil base

oil of above-mentioned this invention Heavy gas oil (HGO) and/or a vacuum gas oil (VGO) A silica alumina, It hydrocracks under existence of the hydrocracking catalyst which makes an alumina and/or a zeolite support and contains periodic-table 6 group's metal and/or eight to 10 group's (IUPAC 1991 periodic table) metal. Carry out distillation separation of the decomposition product concerned at a fuel oil fraction and a lubricating oil fraction, perform dewaxing processing by solvent dewaxing and/or hydrogenation dewaxing to the lubricating oil fraction concerned, and a part for a wax is removed from this fraction. Under existence of the hydrogenation catalyst which makes a silica alumina and/or an alumina support for the obtained dewaxing lubricating oil fraction, and contains periodic-table 6 group's metal and/or eight to 10 group's metal A hydrogen treating is carried out on condition that total pressure 170–230kg/cm²G, the reaction temperature of 220–370 degrees C, and supply liquid-space-velocity (LHSV) 0.2–1.5hr⁻¹. The approach characterized by carrying out separation recovery of the fraction which is in the range whose boiling point in ordinary pressure is 300–520 degrees C by distillation is collectively offered from this generation oil. In addition, this approach, i.e., the approach of this invention, may be called Approach A.

[0016] This invention as the suitable manufacture approach of the lubricating oil of above-mentioned this invention furthermore, heavy gas oil (HGO) and/or a vacuum gas oil (VGO) It hydrocracks under existence of the hydrocracking catalyst which makes a silica alumina, an alumina, and/or a zeolite support, and contains periodic-table 6 group's metal and/or eight to 10 group's metal. Carry out distillation separation of the decomposition product concerned at a fuel oil fraction and a lubricating oil fraction, and distillation separation of the fuel oil fraction concerned is carried out further at a light fraction and a heavy fraction. Dewaxing processing by solvent dewaxing and/or hydrogenation dewaxing is performed to a mixed fraction with a lubricating oil fraction and the heavy fraction concerned, a part for a wax is removed from this mixed fraction, and a dewaxing mixing fraction is obtained. Dewaxing processing by solvent dewaxing and/or hydrogenation dewaxing is performed to each of the lubricating oil fraction concerned and the heavy fraction concerned, a part for a wax is removed from each fraction, and a dewaxing lubricating oil fraction and a dewaxing heavy fraction are obtained. Subsequently Under existence of the hydrogenation catalyst which makes a silica alumina and/or an alumina support for the mixture of the dewaxing mixing fraction concerned or the dewaxing lubricating oil fraction concerned, and the dewaxing heavy fraction concerned, and contains periodic-table 6 group's metal and/or eight to 10 group's metal A hydrogen treating is carried out on condition that total pressure 170–230kg/cm²G, the reaction temperature of 220–370 degrees C, and supply liquid-space-velocity (LHSV) 0.2–1.5hr⁻¹. The approach characterized by carrying out separation recovery of the fraction which is in the range whose boiling point in ordinary pressure is 300–520 degrees C by distillation is collectively offered from this generation oil. In addition, this approach, i.e., the approach of this invention, may be called Approach B.

[0017]

[Embodiment of the Invention] Hereafter, the lubricating oil base oil of this invention is first explained to a detail.

[0018] Although it is realizable as a thing of various presentations or description according to the purpose and the manufacture approach, as for the lubricating oil base oil of this invention, it is important to have satisfied all the conditions of the aforementioned ** – ** at least.

[0019] That is, it is important for the lubricating oil base oil of this invention that it is in the range whose boiling point in ordinary pressure is 300–520 degrees C, and its fraction which is 330–510 degrees C is especially desirable. If the boiling point contains the fraction of a high-boiling point remarkably exceeding a less than 300-degree C low-boiling point fraction or 520 degrees C, the basic property as lubricating oil base oil may not fully be demonstrated, for example, an evaporation loss will increase or it will be easy to produce trouble, such as becoming an increase of energy loss by viscous drag size, here. However, although various additives, such as an oxidation stability improver, are generally added usually according to the purpose in case various kinds of lubricating oils are prepared using this lubricating oil base oil, there is especially no limit about the additive added in that case, and the thing of the usual various boiling points may be added suitably.

[0020] Although it is hydrocarbon mixture which is the thing of a hydrocarbon system and generally uses saturated hydrocarbon, such as n-paraffin, a branched paraffin, and a naphthene hydrocarbon, as a principal component, though the lubricating oil base oil of this invention contains aromatic hydrocarbon, it is important also for the amount of all aromatic series being 1.8 or less % of the weight, and that [its] the amount of [whose] all aromatic series is 1.0 or less % of the weight especially is desirable. The value for all aromatic series here is measured by the approach of ASTM-D -2549 (following, the same). Thus, by making a total aromatic series content into the low value of 1.8 or less % of the weight, the stability over heat, light, oxidation, etc. is fully securable, it is fully stable and the lubricating oil excellent in endurance can be realized easily. Of course, you may use it for it, adding suitably various kinds of well-known stabilizer or well-known stabilization assistants, such as an oxidation stabilizer, etc. also in the case of the lubricating oil base oil of this invention, and raising stability and endurance to it further if needed.

[0021] Moreover, that it is in the range which is 15-25mm²/s also has the important kinematic viscosity in 40 degrees C, and, as for the lubricating oil base oil of this invention, what is in the range whose kinematic viscosity in 40 degrees C is 18-22mm²/s especially is desirable. That is, the lubricating oil base oil of this invention is characterized by having an above comparatively low kinematic viscosity property, and is hypoviscosity lubricating oil base oil of high performance.

[0022] Moreover, the lubricating oil base oil of this invention is important also for a viscosity index being 107 or more, and that [its] whose viscosity index is 110 or more especially is desirable. Since the viscosity index has the high value or more of 107 in this way, by applying this as base oil of a lubricating oil, the lubricating oil base oil of this invention can fully expand the application temperature requirement of the lubricating oil, and can attain multi-grade-ization of a lubricating oil suitably. Also in the case of the lubricating oil base oil of this invention, the additive for improving viscosity indexes, such as polymethacrylate, like the conventional thing can also be used, adding to it suitably, but in the case of this invention, since there may be few such additives than the conventional case, there is an advantage that the fall (for example, fall of shear stability) of the other physical properties and property which tend to be produced by addition of an additive can be controlled to the minimum. In addition, the lubricating oil base oil of this invention possesses high shear stability.

[0023] Furthermore, the lubricating oil base oil of this invention is important also for the pour point being -10.0 degrees C or less, and that [its] whose pour point is -15 degrees C or less especially is desirable. By this, the cold-temperature fluidity of a lubricating oil can be secured and it can fully respond also to the use in a low-temperature environment.

[0024] Moreover, although the lubricating oil base oil of this invention has the stability over heat sufficient also by itself, light, oxidation, etc., various kinds of stabilizers, stabilization assistants, etc., such as an oxidation stabilizer, can be added and used for it if needed. As this oxidation stabilizer etc., although various kinds of well-known things, such as the below-mentioned thing, are usable, it is important for the lubricating oil base oil of this invention that the oxidation stability when adding 2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight is also 410 minutes or more in a RBOT value (in addition, a RBOT value is measured by ASTM-D -2272 in this case). Of course, this does not mean always adding and using DBPC, can show that oxidation stability high enough is very securable as mentioned above with addition of the oxidation stabilizer of a minute amount, and can add and use the oxidation stabilizer of arbitration at a rate of arbitration if needed.

[0025] If the lubricating oil base oil of this invention has satisfied the conditions of the above-mentioned ** - ** at least as mentioned above, although there is especially no limit about general physical properties, descriptions, etc. other than these, what is generally in the range whose aniline point is 100-120 degrees C is desirable, and a thing 200 degrees C or more is desirable about the flash point, and, speaking of a hue, +20 or more things are desirable in for example, a Saybolt color.

[0026] As mentioned above, the lubricating oil base oil of this invention is excellent in the radical genuine article nature as lubricating oil base oil for preparing the lubricating oil of various kinds

of high performance. It has a hyperviscous characteristic especially. Also, in itself, the amount of aromatic series is few enough. Heat, It excels in the stability over light, oxidation, etc. also by addition of stabilizers, such as an oxidation stabilizer of a minute amount, heat, It is hypoviscosity lubricating oil base oil of the high performance which has the various advantages of fully being able to attain the further improvement in the stability over light, oxidation, etc. It can be used very advantageously as base oil for preparing the optimal lubricating oil for various kinds of applications by responding to the purpose, adjusting and optimizing the physical properties and description of **, or selecting and adjusting other physical properties and descriptions suitably within the limits of the above.

[0027] In addition, it responds to the purpose, and various kinds of additives can be used for the lubricating oil base oil of this invention, mixing or adding to it. That is, although itself of the lubricating oil base oil of this invention is also usable as a lubricating oil, it is good to use it as a lubricating oil which added various kinds of additives according to the purpose, and suited each application so that it may generally usually be carried out.

[0028] As an additive, various kinds of things, such as a well-known thing, are usable. As this additive for example Phenol systems, such as 2 and 6-JITA chalis butyl-p-cresol, Antioxidants, such as an amine system, a sulfur system, a thiophosphoric acid zinc system, and a phenothiazine system, Molybdenum dithiophosphate, a molybdenum dithio carbamate, molybdenum disulfide, Fluoride carbon, way acid ester, fatty amine, higher alcohol, Friction reduction agents, such as a higher fatty acid, fatty acid ester, and a fatty-acid amide, tricresyl phosphate, Extreme pressure agents, such as triphenyl phosphate and dithiophosphate zinc, petroleum sulfonate, Rust preventives, such as alkylbenzene sulfonate and dinonyl naphthalene sulfonate, Metal deactivators, such as benzotriazol, alkaline-earth-metal sulfonate, Metal system detergent, such as alkali earth metal phenate, an alkaline-earth-metal SARISHI rate, and alkaline-earth-metal phosphonate, viscosity index improvers, such as defoaming agents, such as silicone, polymethacrylate, a polyisobutylene, and polystyrene, a pour point depressant, etc. are mentioned, and independent in these -- or two or more sorts can be combined and it can add.

[0029] as the base oil of the lubricating oil of high performance to which the lubricating oil base oil of this invention suited said application of the various kinds carried out -- suitable -- use -- things are made.

[0030] As the general manufacture approach, although there is no lubricating oil base oil of this invention, it can manufacture especially a limit with suitably and sufficient productivity by the approach of said this invention. Moreover, as for the lubricating oil base oil of this invention, what was manufactured by this approach A especially is desirable.

[0031] Hereafter, the approach A of this invention which is the suitable manufacture approach of the lubricating oil base oil of this invention is explained to a detail.

[0032] In this approach A, heavy gas oil (HGO), a vacuum gas oil (VGO), or the mixed oil of the rate of such arbitration is used as stock oil. As this stock oil, the thing from various kinds of crude oils etc. is usable.

[0033] From this stock oil, target lubricating oil base oil is fundamentally manufactured according to the essential-oil process which consists of a hydrocracking process, a distillation process, a dewaxing (wax part removal) process, a hydrogen-treating (dearomatic series) process, and a distillation process, as shown below.

[0034] (Process A-1) hydrogenation part -- as stock oil with which this hydrocracking is presented, fundamentally, although said heavy gas oil (HGO), a vacuum gas oil (VGO), or the mixed oil of the rate of such arbitration is used, optimum dose addition of the recycle oil from a latter process may be carried out suitably, and a reaction may be presented at these if needed.

[0035] Hydrocracking is usually suitably carried out under the terms and conditions shown below.

[0036] That is, reaction pressure is total pressure and it is usually suitable for it preferably 100-190kg/cm²G and to select in the range of 130-180kg/cm²G.

[0037] 3 and 500-1500Nm of adjusting 800-1200Nm of rates of supply hydrogen gas to the range of 3 preferably to 1kl of supply oils are usually appropriate.

[0038] It is usually suitable for reaction temperature preferably to select [340-440-degree C]

in the range of 350–420 degrees C.

[0039] moreover, liquid space velocity (LHSV) -- supply oil criteria -- it is -- usually -- 0.3–1.5hr⁻¹ -- what is necessary is just to adjust suitably in the range of 0.5–1.2hr⁻¹ preferably

[0040] The hydrocracking catalyst which makes a silica alumina, an alumina, and/or a zeolite support, and contains periodic-table 6 group's metal and/or eight to 10 group's metal as a catalyst used for this hydrocracking is used. Here, as a periodic-table 6 group metal, Cr, Mo, and W can be mentioned and Mo and W are usually desirable also in these. As a periodic table 8 – 10 group metals, although Fe, Co, nickel, Rh, Ru, Pd, Os, Ir, and Pt can be mentioned, nickel etc. is usually desirable. Although these metals can be used by the one-sort independent and can also be used combining two or more sorts according to a case, combination, such as nickel–Mo and nickel–W, is usually suitable for them. In addition, although various kinds of things, such as an X type, Y mold, and B mold, are usable when using a zeolite, Y mold etc. is used suitably even especially in inside. Moreover, the support of two or more classes may be used suitably, mixing or compounding. For example, in the case of a zeolite, what used the alumina, the silica alumina, etc. as a matrix and fabricated them to this is used suitably. Furthermore, as this catalyst, the thing containing support component metallurgy group components other than the above is also usable suitably.

[0041] (Process A-2) At the process of *****, distillation separates into a lubricating oil fraction, a fuel oil fraction, etc. the decomposition generation oil obtained by hydrocracking of the above-mentioned process A-1. As a lubricating oil fraction, it is good preferably the fraction of 250–540 degrees C of boiling ranges, and to carry out separation recovery of the fraction of 300–530 degrees C of boiling ranges, and, for that purpose, a fuel oil fraction is usually good in that case, to dissociate so that the terminal point of the boiling point may become 250–390 degrees C. In addition, the boiling point of ordinary pressure or ordinary pressure conversion has shown each boiling point (following, the same).

[0042] In this way, although the lubricating oil fraction in the separated predetermined boiling range is sent to the following process A-3 and dewaxing processing is presented with it, it may recycle this a part of lubricating oil fraction at the above-mentioned process A-1 if needed. On the other hand, fuel oil and recovery gas which were separated can be used effective in each application.

[0043] (Process A-3) At the process A-3 of *****, dewaxing processing of the lubricating oil fraction obtained at the above-mentioned process A-2 is carried out, and a part for a wax (a part for a wax) is fully removed. This dewaxing is performed with the hydrogenation dewaxing process (b) which hydrogenates using the following solvent dewaxing process (a) or following catalyst by solvent extraction. In addition, if needed, (b) may be combined with (a), and (b) may be suitably, carried out after (a) in that case, or (a) may be conversely performed after (b). However, the following (a) or (b) can usually perform sufficient dewaxing.

[0044] (a) MEK usually using a methyl ethyl ketone (MEK) as an extract solvent component although various kinds of well-known solvent dewaxing processes using various kinds of solvents as a solvent dewaxing process of ***** are applicable -- law is used suitably. Although dewaxing processing by this MEK method can be fundamentally performed according to a conventional method, it is usually suitable to carry out under the following terms and conditions.

[0045] namely, -- as a dewaxing solvent -- from MEK and toluene -- becoming -- MEK -- 30 to 70 capacity % -- desirable -- 35 to 50 capacity % -- it is -- this -- corresponding -- toluene -- 70 to 30 capacity % -- the thing of a presentation of 65 – 50 capacity % is used suitably preferably. In addition, the solvent which carried out optimum dose addition of other solvents other than MEK and toluene suitably may be used if needed.

[0046] supply of said lubricating oil fraction with which said dewaxing solvent and dewaxing processing are presented -- although there is especially no limit if it carries out comparatively -- usually -- a capacity factor (a supply solvent / supply lubricating oil fraction) -- 1.0–6.0 -- it is suitable although preferably dewaxed by selecting in the range of 1.5–4.5.

[0047] although there is especially no limit as temperature of dewaxing processing in that case -- the temperature of the solvent at the time of dewaxing -- usually –45-- it is suitable to carry out –10 degrees C preferably, so that it may be held in the range of –40--15 degree C.

[0048] Extract removal of a part for a wax is carried out from said lubricating oil fraction as mentioned above, it dissociates with a solvent and the lubricating oil fractions which removed a part for a wax are collected. In addition, in order to fully remove a part for a wax, it is desirable to carry out so that it may usually become the range of 60 – 85 capacity % to the raw material lubricating oil fraction which the yield of a recovery lubricating oil fraction used.

[0049] (b) Dewax under existence of a suitable catalyst by the hydrogenation dewaxing this gentleman method by carrying out catalytic reaction of said lubricating oil fraction to hydrogen. Although this hydrogenation dewaxing can also be fundamentally performed according to a conventional method, it can usually make suitably by performing the hydrogenation reaction for dewaxing under the following terms and conditions.

[0050] As a catalyst, although various kinds of things are usable, the zeolite of ZSM-5 or ZSM-5 mold is usually used suitably.

[0051] It is usually appropriate 20–100kg/cm²G and to select the total pressure of a reaction in the range of 25–70kg/cm²G preferably.

[0052] It is usually suitable for reaction temperature preferably to select [230–360-degree C] in the range of 250–350 degrees C.

[0053] Liquid space velocity (LHSV) is supply oil (lubricating oil fraction) criteria, and it is usually appropriate for it preferably 0.3–3.0hr⁻¹ and to select in the range of 0.5–2.5hr⁻¹.

[0054] Vapor liquid separation of the product is carried out after a reaction, and the lubricating oil fractions by which the request was further dewaxed by performing after treatment, such as distillation or solvent extraction, if needed are collected. However, the method supplied to the following hydrogen-treating process as it is without carrying out vapor liquid separation of the product depending on the case may be adopted.

[0055] (Process A-4) Hydrogen treating (dearomatic series processing)

At this process A-4, the hydrogen treating of the dewaxing lubricating oil fraction obtained at the above-mentioned process A-3 is carried out under existence of a predetermined hydrogen-treating catalyst, and the purification lubricating oil fraction by which the aromatic compound contained in this raw material lubricating oil fraction was hydrogenated, and a part for aromatic series was reduced below at the predetermined value is obtained.

[0056] The hydrogenation catalyst which makes a silica alumina and/or an alumina support and contains periodic-table 6 group's metal and/or eight to 10 group's metal as a catalyst used for this hydrogen-treating reaction is used. Here, as a periodic-table 6 group metal, Cr, Mo, and W can be mentioned and Mo and W are usually desirable also in these. As a periodic table 8 – 10 group metals, although Fe, Co, nickel, Rh, Ru, Pd, Os, Ir, and Pt can be mentioned, nickel etc. is usually desirable. Although these metals can be used by the one-sort independent and can also be used combining two or more sorts according to a case, combination, such as nickel-Mo and nickel-W, is usually suitable for them. In addition, the support of two or more classes may be used suitably, mixing or compound-izing. What can apply various kinds of well-known things as this catalyst, and contains support component metallurgy group components other than the above is usable suitably.

[0057] It is characterized by performing the hydrogen treating for this dearomatic series under high pressure rather than the conventional case, and it is important to carry out under the following terms and conditions.

[0058] That is, as for this hydrogen treating, it is desirable to select reaction pressure in the range which it is important to be total pressure and to carry out by selecting in the range of 170–230kg/cm²G, and is 180–220kg/cm²G especially, and to carry out.

[0059] Here, since sufficient dearomatization is not made as reaction pressure (total pressure) is under 170kg/cm²G, the purpose of this invention cannot fully be attained. Since reaction pressure needs the special equipment which bears high pressure so much above 230kg/cm²G and facility cost becomes high on the other hand, it is uneconomical.

[0060] Thus, sufficient dearomatic series becomes possible, without pretreating solvent refining by the furfural of a raw material lubricating oil fraction which was conventionally performed by reacting in the high-pressure range rather than a conventional method as mentioned above etc. (preceding paragraph dearomatic series processing). Therefore, by the approach of this invention,

the part process is simplified and it becomes remarkably [that it is economical and] advantageous.

[0061] In addition, 3 and 250-1500Nm of adjusting 300-1200Nm of rates of the supply hydrogen gas in this hydrogen treating to the range of 3 preferably to 1kl of supply oils are usually appropriate.

[0062] As for reaction temperature, it is important to select in the range of 220-370 degrees C, and it is desirable to select especially in the range which is 230-360 degrees C. If it becomes insufficient [less than 220 degrees C] dearomatizing reaction temperature and it exceeds 370 degrees C on the other hand, it will become impossible to disregard side reaction, such as a hydrocracking reaction, the yield of a desired lubricating oil fraction will fall, and the disadvantage on a process will be caused.

[0063] moreover, this hydrogen-treating reaction -- liquid space velocity (LHSV) -- supply oil criteria -- it is -- $0.2-1.5\text{hr}^{-1}$ -- preferably, it adjusts suitably in the range of $0.3-1.0\text{hr}^{-1}$, and carries out in it. Less than [0.2hr^{-1}], productivity worsens, and on the other hand, if LHSV is larger than 1.5hr^{-1} , it cannot attain sufficient dearomatization.

[0064] The generation oil obtained by the hydrogen treating as mentioned above is sent to the following distillation process, and distillation separation is carried out.

[0065] (Process A-5) Distillation (recovery of low aromatic series lubricating oil base oil made into the purpose)

At this process A-5, the generation oil obtained by the hydrogen treating of the above-mentioned process A-4 is distilled, and the lubricating oil base oil (desirable mode of the lubricating oil base oil of this invention) made into the purpose is obtained.

[0066] Although this distillation can be performed according to a conventional method, a boiling range carries out separation recovery of the 300-520 degrees C of the lubricating oil base oil made into the purpose as a 330-510-degree C fraction preferably.

[0067] It is cheap, and according to the above process A-1 to A-5, from the low heavy gas oil of added value, a vacuum gas oil, or its mixture, it is efficient and, moreover, the lubricating oil base oil of the high performance which is the desirable mode of the lubricating oil base oil of this invention which satisfies the conditions of the aforementioned ** - ** can be manufactured with sufficient productivity by low cost.

[0068] In this way, the obtained lubricating oil base oil can be used in favor of various kinds of above mentioned applications.

[0069] Next, the approach B of this invention which are other suitable manufacture approaches of the lubricating oil base oil of this invention is explained to a detail.

[0070] The fuel oil fraction which obtained by distillation of the hydrocracking oil of stock oil in the above-mentioned approach A, and was obtained with the hydrocracking oil of stock oil in this approach B to manufacturing the lubricating oil base oil of this invention by performing and distilling the above-mentioned hydrogen treating only to a lubricating oil fraction is distilled further, it separates into a light fraction and a heavy fraction, that heavy fraction is used with a lubricating oil fraction, and the lubricating oil base oil of this invention is manufactured. According to this approach B, a part for heavy [in a fuel oil fraction] can be used effectively as a raw material of the lubricating oil base oil which was excellent in this invention, the lubricating oil base oil (lubricating oil base oil A may be called hereafter) and viscosity grade of this invention differ from each other, and lubricating oil base oil (lubricating oil base oil B may be called hereafter) excellent in stability is obtained as a by-product.

[0071] In this approach B, heavy gas oil (HGO), a vacuum gas oil (VGO), or the mixed oil of the rate of such arbitration is used as stock oil like Approach A. As this stock oil, the thing from various kinds of crude oils etc. is usable.

[0072] The refinery process of this approach B consists of the hydrocracking process, the distillation process (distillation process ** and distillation process **), the dewaxing (wax part removal) process, hydrogen-treating (dearomatic series) process, and distillation process of this stock oil fundamentally, as shown below.

[0073] (Process B-1) hydrogenation part ** -- the conditions of the stock oil with which this hydrocracking is presented, and hydrocracking are the same as the process A-1 Of Approach A.

[0074] (Process B-2) distillation process ** -- in this distillation process **, distillation separates into a lubricating oil fraction, a fuel oil fraction, etc. the decomposition generation oil obtained by hydrocracking of the above-mentioned process B-1 like Approach A. Like Approach A, as a lubricating oil fraction, it is good preferably the fraction of 250-540 degrees C of boiling ranges, and to carry out separation recovery of the fraction of 300-530 degrees C of boiling ranges, and, for that purpose, it is usually good [a fuel oil fraction] to dissociate so that the terminal point of the boiling point may become 250-390 degrees C.

[0075] In this way, a part of separated lubricating oil fraction may be recycled at the above-mentioned process B-1 like Approach A if needed. On the other hand, recovery gas can be used effectively in each application.

[0076] distillation process ** -- in this distillation process **, the fuel oil fraction obtained by the above-mentioned distillation process ** is distilled further, and it separates into a light fraction and a heavy fraction. As a heavy fraction, it is good preferably the fraction of 240-390 degrees C of boiling ranges, and to carry out separation recovery of the fraction of 270-390 degrees C of boiling ranges, and, for that purpose, a light fraction is usually good in that case, to dissociate so that the terminal point of the boiling point may become 230-320 degrees C.

[0077] In this way, the separated light fraction can be used effectively in the application as fuel oil etc.

[0078] (Process B-3) At the process B-3 of *****, dewaxing processing is performed to the mixed fraction of the lubricating oil fraction obtained by distillation process ** of the (1) above-mentioned process B-2, and the heavy fraction obtained by distillation process **, a dewaxing mixing fraction is obtained, or dewaxing processing is separately performed to each of the (2) above-mentioned lubricating oil fraction and the above-mentioned heavy fraction, and a dewaxing lubricating oil fraction and a dewaxing heavy fraction are obtained.

[0079] The above (1) and in the case of (2), this dewaxing is similarly performed [both] in the process A-3 of Approach A with the hydrogenation dewaxing process (b) which hydrogenates using the solvent dewaxing process (a) or catalyst by solvent extraction. In addition, if needed, (b) may be combined with (a), and (b) may be suitably carried out after (a) in that case, or (a) may be conversely performed after (b). However, the following (a) or (b) can usually perform sufficient dewaxing.

[0080] The classes of the solvent dewaxing process suitably adopted in this process B-3 and hydrogenation dewaxing process, those conditions, etc. are the same also in the process A-3 of Approach A as they are shown below.

[0081] (a) The same thing is used with having explained solvent dewaxing in Approach A as a solvent used for solvent dewaxing solvent dewaxing.

[0082] In the supply rate of said mixed fraction with which said dewaxing solvent and dewaxing processing are presented, and a list, as a supply rate of said lubricating oil fraction and a heavy fraction usually, a capacity factor (a supply solvent / supply mixing fraction, a supply solvent / supply lubricating oil fraction, or a supply solvent / supply heavy fraction) -- 1.0-6.0 -- preferably although it is suitable although dewaxed by selecting in the range of 1.5-4.5, and there is especially no limit as temperature of dewaxing processing -- the temperature of the solvent at the time of dewaxing -- usually -45- it is suitable to carry out -10 degrees C preferably, so that it may be held in the range of -40--15 degree C.

[0083] the dewaxing mixing fraction which carried out extract removal of the part for a wax separately from each of said lubricating oil fraction and a heavy fraction from said mixed fraction as mentioned above, and removed a part for a wax -- or it dissociates with a solvent and each of a dewaxing lubricating oil fraction and a dewaxing heavy fraction is collected. In addition, in order to fully remove a part for a wax, it is desirable to carry out so that the yield of a recovery dewaxing mixing fraction, a recovery dewaxing lubricating oil fraction, or a recovery dewaxing heavy fraction may usually become the range of 60 - 85 capacity % to the used raw material mixing fraction, raw material lubricating oil fraction, or raw material heavy fraction.

[0084] (b) the bottom of existence of a catalyst suitable by the hydrogenation dewaxing this gentleman method -- said mixed fraction -- or dewax by carrying out catalytic reaction of said lubricating oil fraction and heavy fraction to hydrogen separately. Although this hydrogenation

dewaxing can also be fundamentally performed according to a conventional method, it can usually make suitably by performing the hydrogenation reaction for dewaxing under the following terms and conditions.

[0085] As a catalyst, although various kinds of things are usable, the zeolite of ZSM-5 or ZSM-5 mold is usually used suitably.

[0086] It is usually appropriate 20-100kg/cm²G and to select the total pressure of a reaction in the range of 25-70kg/cm²G preferably.

[0087] It is usually suitable for reaction temperature preferably to select [230-360-degree C] in the range of 250-350 degrees C.

[0088] Liquid space velocity (LHSV) is supply oil (mixed fraction, lubricating oil fraction, or heavy fraction) criteria, and it is usually appropriate for it preferably 0.3-3.0hr⁻¹ and to select in the range of 0.5-2.5hr⁻¹.

[0089] Vapor liquid separation of the product is carried out after a reaction, and the dewaxing mixing fraction by which the request was further dewaxed by performing after treatment, such as distillation or solvent extraction, if needed or a dewaxing lubricating oil fraction, and dewaxing heavy fractions are collected. However, the method supplied to the following hydrogen-treating process as it is without carrying out vapor liquid separation of the product depending on the case may be adopted.

[0090] (Process B-4) Hydrogen treating (dearomatic series processing)

At this process B-4, the hydrogen treating of the mixture of the dewaxing mixing fraction obtained at the above-mentioned process B-3 or the dewaxing lubricating oil fraction concerned, and the dewaxing heavy fraction concerned is carried out under existence of a predetermined hydrogen-treating catalyst, and the purification fraction by which the aromatic compound contained in this raw material dewaxing mixing fraction or the mixture of a dewaxing lubricating oil fraction and a dewaxing heavy fraction was hydrogenated, and a part for aromatic series was reduced below at the predetermined value is obtained.

[0091] The catalyst used for this hydrogen-treating reaction and the conditions of a hydrogen treating are the same as the process A-4 in Approach A.

[0092] (Process B-5) Distillation (recovery of low aromatic series lubricating oil base oil A and the low aromatic series lubricating oil base oil B as a by-product made into the purpose)

At this process B-5, the generation oil obtained by the hydrogen treating of the above-mentioned process B-4 is distilled, and the lubricating oil base oil A (desirable mode of the lubricating oil base oil of this invention) made into the purpose and the lubricating oil base oil B as a by-product are obtained.

[0093] Although this distillation can be performed according to a conventional method, as for the lubricating oil base oil A with which are satisfied of above-mentioned condition ** made into the purpose - **, 300-520 degrees C of boiling ranges carry out separation recovery as a 330-510-degree C fraction preferably.

[0094] Moreover, in this distillation, when a boiling range separates preferably 250-430 degrees C of 260-420-degree C fractions, unlike lubricating oil base oil A, viscosity grade can collect the lubricating oil base oil B which has stability sufficient as lubricating oil base oil as a by-product.

[0095] This lubricating oil base oil B is in the range whose boiling point in (a) ordinary pressure it is lubricating oil base oil of a hydrocarbon system, and is 250-430 degrees C. (b) It is in the range the amount of [whose] all aromatic series is 1.8 or less % of the weight and whose kinematic viscosity in (c) 40 degree C is 5-10mm²/s. (d) A viscosity index is 95 or more, and (e) pour point is -10 degrees C or less, and the oxidation stability when adding 2 and 6-JITA challs butyl-p-cresol (DBPC) 0.5% of the weight is a thing for 340 minutes or more in a RBOT value.

[0096] That is, it is important for lubricating oil base oil B that it is in the range whose boiling point in ordinary pressure is 250-430 degrees C, and its fraction which is 260-420 degrees C is especially desirable.

[0097] It is the thing of a hydrocarbon system, generally, lubricating oil base oil B is hydrocarbon mixture which uses saturated hydrocarbon, such as n-paraffin, a branched paraffin, and a naphthene hydrocarbon, as a principal component, it is important for it that the amount of all aromatic series is 1.8 or less % of the weight though aromatic hydrocarbon is contained, and that

[its] the amount of [wh all aromatic series is 1.2 or less % of th ight especially is desirable.

[0098] Moreover, as for lubricating oil base oil B, what is in the range whose kinematic viscosity in 40 degrees C is 5-10mm²/s, and is in the range whose kinematic viscosity in 40 degrees C is 6-9mm²/s especially is desirable. That is, lubricating oil base oil B is characterized by having a kinematic viscosity property [as mentioned above] lower than the lubricating oil base oil of this invention, and is hypoviscosity lubricating oil base oil of high performance.

[0099] Moreover, a viscosity index is 95 or more and lubricating oil base oil B has that desirable whose viscosity index is 98 or more especially. Since the viscosity index has the comparatively high value or more of 95 in this way, by applying this as base oil of a lubricating oil, lubricating oil base oil B can fully expand the application temperature requirement of the lubricating oil, and can attain multi-grade-ization of a lubricating oil suitably. Also in the case of this lubricating oil base oil B, the additive for improving viscosity indexes, such as polymethacrylate, like the conventional thing can also be used, adding to it suitably, but in the case of this lubricating oil base oil B, since there may be few such additives than the conventional case, there is an advantage that the fall (for example, fall of shear stability) of the other physical properties and property which tend to be produced by addition of an additive can be controlled to the minimum. In addition, this lubricating oil base oil B possesses high shear stability.

[0100] Furthermore, lubricating oil base oil B is important also for the pour point being -10.0 degrees C or less, and that [its] whose pour point is -15 degrees C or less especially is desirable. By this, the cold-temperature fluidity of a lubricating oil can be secured and it can fully respond also to the use in a low-temperature environment.

[0101] Moreover, although lubricating oil base oil B has the stability over heat, light, oxidation, etc. also in itself, it can add and use various kinds of stabilizers, stabilization assistants, etc., such as an oxidation stabilizer, if needed. As this oxidation stabilizer etc., various kinds of well-known things, such as what was indicated previously, are usable. In addition, this lubricating oil base oil B has the description that the oxidation stability when adding 2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight is 340 minutes or more in a RBOT value.

[0102] Generally it is in the range whose aniline point is 95-110 degrees C, and the flash point is 150 degrees C or more, and, speaking of a hue, the lubricating oil base oil B obtained in the approach B of this invention is +20 or more things for example, in a Saybolt color.

[0103] As mentioned above, the lubricating oil base oil B obtained as a by-product in Approach B It has a comparatively high viscosity index. Also in itself, the amount of aromatic series few enough Heat, It excels in the stability over light, oxidation, etc. by addition of stabilizers, such as an oxidation stabilizer of a **** minute amount, heat, By being the outstanding hypoviscosity lubricating oil base oil which has the various advantages of fully being able to attain the further improvement in the stability over light, oxidation, etc., responding to the purpose, and adjusting and optimizing physical properties and description with the above-mentioned additive etc. It can be used very advantageous as base oil for preparing the optimal lubricating oil for various kinds of applications.

[0104] Are cheap by the above process B-1 to B-5. Namely, from the low heavy gas oil of added value, a vacuum gas oil, or its mixture While it is efficient and being able to manufacture the lubricating oil base oil A of the high performance which is the desirable mode of the lubricating oil base oil of this invention which satisfies the conditions of the aforementioned ** - ** with sufficient productivity moreover by low cost Viscosity grade can obtain the lubricating oil base oil B which shows the stability which was excellent similarly to heat, light, and oxidation unlike lubricating oil base oil A as a by-product.

[Translation done.]

* NOTICES *

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.*** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

EXAMPLE

[Example] Although the example and its example of a comparison of this invention are shown below and this invention is explained to it still more concretely, this invention is not limited to this example.

[0106] Hydrocracking was performed by total pressure 160kg/cm²G, the reaction temperature of 380 degrees C, LHSV1.0h⁻¹, and hydrogen / oil ratio 1000Nm³/kl under existence of the catalyst system which contains nickel and molybdenum in alumina support, and the catalyst system which contains nickel and molybdenum in an alumina +Y mold zeolite, using the heavy gas oil and the mixed oil of a vacuum gas oil which are shown in example 1 table 1 as stock oil.

[0107] 60 % of the weight (the terminal point of the boiling point is 370 degrees C) of fuel oil fractions and 40 % of the weight (320-530 degrees C of boiling ranges) of lubricating oil fractions were obtained with atmospheric distillation in the decomposition generation oil, respectively.

[0108] next -- a lubricating oil fraction -- MEK / toluene (capacity factors 5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of -27.5 degrees C. Dewaxing yield was 72 capacity %.

[0109] The viscosity index of the kinematic viscosity of this dewaxed oil was 118 in 24.2mm²/s (@40 degree C). The pour point at this time was -17.5 degrees C.

[0110] Next, the hydrogen treating was performed using the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil by the reaction temperature of 290 degrees C, total pressure 210kg/cm²G, LHSV0.5h⁻¹, and hydrogen / oil ratio 360Nm³/kl.

[0111] Subsequently, the lubricating oil base oil of 330-510 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation. The yield of this lubricating oil base oil was 76 % of the weight to dewaxed oil.

[0112] As shown in Table 2, the amount of aromatic series is as low as 0.46wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is as long as 436 minutes, and the heat instability test is passed further easily. Moreover, the pour point of the viscosity index at this time was -17.5 degrees C in 118.

[0113] Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily.

[0114] It carried out on the process and conditions as an example 1 with same example of comparison 1 hydrocracking, distillation, and dewaxing, and reaction temperature of hydrogen-treating conditions was carried out at 290 degrees C, the hydrogen treating of the total pressure was carried out by 160kg/cm²G, LHSV0.5h⁻¹, and hydrogen / oil ratio 360Nm³/kl, and, subsequently the lubricating oil base oil of 330-510 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation.

[0115] As shown in Table 2, the amount of aromatic series is 3.7wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is 405 minutes, and the heat instability test passes. Moreover, kinematic viscosity was 20.5mm²/s (@40 degree C), and the pour point of the viscosity index at this time was -17.5 degrees C in 118. The weathering test became a rejection.

[0116] It carried out on the process and conditions as an example 1 with same example of comparison 2 hydrocracking, distillation, and dewaxing, and, subsequently to 330-510 degrees-C

fraction of boiling ranges, associated by distillation, furfural solvent refining of this fraction was carried out, and lubricating oil base oil was obtained.

[0117] As this base oil was shown in Table 2, the amount of aromatic series was as high as 6.6wt (s)%, and oxidation stability (RBOT@ additive 0.5wt% addition) was also 358 minutes. The weathering test became a rejection like the example 1 of a comparison.

[0118]

[Table 1]

原料油	重質軽油	減圧軽油
密度、g/cm ³ @15℃	0.879	0.913
動粘度、mm ² /s@50℃	10.5	29.9
硫黄分、wt %	1.0	2.0
窒素分、wt ppm	350	700
蒸留性状、℃ ASTM D2887		
IBP	239	261
10 %	344	376
30 %	378	432
50 %	396	465
70 %	417	493
90 %	445	526
EP	506	561

[0119]

[Table 2]

原 料	実施例1	比較例1	比較例2
	HGO/VGO	HGO/VGO	HGO/VGO
原料比率	5/5	5/5	5/5
水素化分解			
全圧力 kg/cm ²	160	160	160
LHSV h ⁻¹	1.0	1.0	1.0
温度 ℃	380	380	380
溶剤脱ろう			
溶剤/油 vol比	3	3	3
温度 ℃	-28	-28	-28
水素化			
全圧力 kg/cm ²	210	160	-
LHSV h ⁻¹	0.5	0.5	-
溶剤脱芳香族(7075-N)			
溶剤/油 vol比	-	-	2.0
温度 ℃	-	-	110
動粘度 mm ² /s(640℃)	20.5	20.1	20.2
粘度指数	118	118	118
組 成			
芳香族分 wt %	0.46	3.7	6.6
安 定 性			
熱安定性試験*1)			
判定	合格	合格	合格
酸化安定性試験*2) (min)	436	405	358
耐候性試験			
判定	合格 (○)	不合格 (△)	不合格 (×)

*1) JIS K It is based on 2540 (evaluation 12 hours after 170 degree-Cx).

*2) ASTM D It is based on 2272 (additive 0.5wt% addition).

*3) Evaluation 96 hours after being based on the photodegradation accelerated test equipment indicated by JP,1-94241,A. O showed by considering the case where the sample oil after examining all is transparence as success, and when it was alike to that extent, there was cloudiness more and there were ** and precipitate, x showed the rejection.

[0120] Hydrocracking was performed by total pressure 160kg/cm²G, the reaction temperature of 380 degrees C, LHSV1.0h⁻¹, and hydrogen / oil ratio 1000Nm³/kl under existence of the catalyst system which contains nickel and molybdenum in alumina support, and the catalyst system which contains nickel and molybdenum in an alumina +Y mold zeolite, using the heavy gas oil and the mixed oil of a vacuum gas oil which are shown in example 2 table 1 as stock oil.

[0121] By carrying out atmospheric distillation of the decomposition generation oil, 60 % of the weight (the terminal point of the boiling point is 390 degrees C) of fuel oil fractions and 40 % of the weight (320-530 degrees C of boiling ranges) of lubricating oil fractions were obtained, respectively.

[0122] Next, 60 % of the weight (the terminal point of the boiling point is 310 degrees C) of light fractions and 40 % of the weight (270-380 degrees C of boiling ranges) of heavy fractions were obtained by carrying out atmospheric distillation of the fuel oil fraction further, respectively.

[0123] next, lubricating oil fraction 65 capacity % and heavy fraction 35 capacity % of the fuel oil fraction separated by distillation -- mixing -- this mixed fraction -- MEK / toluene (capacity factors 5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of -30 degrees C. Dewaxing yield was 78 capacity %.

[0124] The viscosity index of the kinematic viscosity of this dewaxed oil was 113 in 14.6mm²/s (@40 degree C). The pour point at this time was -22.5 degrees C.

[0125] Next, the hydrogen treating was performed using the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil by the reaction temperature of 290 degrees C, total pressure 210kg/cm²G, LHSV0.5h⁻¹, and hydrogen / oil ratio 360Nm³/kl.

[0126] Subsequently, the lubricating oil base oil A of 374-502 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation. The yield of this lubricating oil base oil A was 66 % of the weight to dewaxed oil.

[0127] As shown in Table 4, the amount of [of lubricating oil base oil A] aromatic series is as low as 0.55wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is as long as 432 minutes, and the heat instability test is passed further easily. Moreover, kinematic viscosity was 20.9mm²/s (@40 degree C), and the pour point of the viscosity index at this time was -22.5 degrees C in 116. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily.

[0128] Moreover, the lubricating oil base oil B of 350-380 degrees-C fraction of boiling ranges was obtained to coincidence at the time of this distillation. The yield of this lubricating oil base oil B was 7 % of the weight to dewaxed oil.

[0129] As shown in Table 4, the amount of [of lubricating oil base oil B] aromatic series is as low as 0.75wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is as long as 415 minutes, and the heat instability test is passed further easily. Moreover, kinematic viscosity was 8.11mm²/s (@40 degree C), and the pour point of the viscosity index at this time was -25 degrees C in 100. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily.

[0130] The process which divides the generation oil from hydrocracking of example 3 stock oil and hydrocracking into a fuel oil fraction and a lubricating oil fraction with atmospheric distillation, and the process which divides a fuel oil fraction into a light fraction and a heavy fraction with atmospheric distillation were performed like the example 2.

[0131] next, lubricating oil fraction 75 capacity % and heavy fraction 25 capacity % of the fuel oil fraction separated by distillation -- mixing -- this mixed fraction -- MEK / toluene (capacity factors 5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was

performed on conditions 3 times and a filtration temperature of — degrees C. Dewaxing yield was 76 capacity %.

[0132] The viscosity index of the kinematic viscosity of this dewaxed oil was 115 in 16.7mm²/s (@40 degree C). The pour point at this time was -22.5 degrees C.

[0133] Next, the hydrogen treating was performed using the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil by the reaction temperature of 290 degrees C, total pressure 210kg/cm²G, LHSV0.5h-1, and hydrogen / oil ratio 360Nm³/kl.

[0134] Subsequently, the lubricating oil base oil A of 385-495 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation. The yield of this lubricating oil base oil A was 72 % of the weight to dewaxed oil.

[0135] As shown in Table 4, the amount of [of lubricating oil base oil A] aromatic series is as low as 0.75wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is as long as 429 minutes, and the heat instability test is passed further easily. Moreover, kinematic viscosity was 20.8mm²/s (@40 degree C), and the pour point of the viscosity index at this time was -22.5 degrees C in 118. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily.

[0136] Moreover, the lubricating oil base oil B of 360-385 degrees-C fraction of boiling ranges was obtained to coincidence at the time of this distillation. The yield of this lubricating oil base oil B was 5 % of the weight to dewaxed oil.

[0137] As shown in Table 4, the amount of [of lubricating oil base oil B] aromatic series is as low as 0.95wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is as long as 380 minutes, and the heat instability test is passed further easily. Moreover, kinematic viscosity was 8.10mm²/s (@40 degree C), and the pour point of the viscosity index at this time was -25 degrees C in 108. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily.

[0138] The process which divides the generation oil from hydrocracking of example of comparison 3 stock oil and hydrocracking into a fuel oil fraction and a lubricating oil fraction with atmospheric distillation, and the process which divides a fuel oil fraction into a light fraction and a heavy fraction with atmospheric distillation were performed like the example 2.

[0139] Subsequently, reaction temperature of hydrogen-treating conditions was carried out at 290 degrees C, the hydrogen treating of the total pressure was carried out by 160kg/cm²G, LHSV0.5h-1, and hydrogen / oil ratio 360Nm³/kl, and, subsequently the lubricating oil base oil of 370-505 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation.

[0140] As shown in Table 5, the amount of aromatic series is 3.5wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is 407 minutes, and the heat instability test passes. Moreover, the pour point of the viscosity index at this time was -22.5 degrees C in 115. The weathering test became a rejection.

[0141] The process which divides the generation oil from hydrocracking of example of comparison 4 stock oil and hydrocracking into a fuel oil fraction and a lubricating oil fraction with atmospheric distillation, and the process which divides a fuel oil fraction into a light fraction and a heavy fraction with atmospheric distillation were performed like the example 2.

[0142] Subsequently, the obtained dewaxed oil was divided into 377-500 degrees-C fraction of boiling ranges by distillation, furfural solvent refining of this fraction was carried out, and lubricating oil base oil was obtained. The yield (rate of furfural extraction) of this base oil was 74 % of the weight.

[0143] As shown in Table 5, this base oil has the amount of aromatic series as high as 6.3wt(s)%, oxidation stability (RBOT@ additive 0.5wt% addition) is also 360 minutes, and the heat instability test passes. Moreover, the viscosity index was 115 and the pour point at this time was -22.5 degrees C. The weathering test became a rejection like the example 3 of a comparison.

[0144]

[Table 3]

原 料	例 2		実施例 3	
	HGO/VGO		HGO/VGO	
原料比率	5/5		5/5	
水素化分解				
全圧力 kg/cm ²	160		160	
LHSV h ⁻¹	1.0		1.0	
温度 °C	380		380	
水素/油比 Nm ³ /kl	1000		1000	
溶剤脱ろう				
溶剤/油 vol比	3		3	
温度 °C	- 30		- 30	
水素化				
温度 °C	290		290	
全圧力 Kg/cm ²	210		210	
LHSV h ⁻¹	0.5		0.5	
水素/油比 Nm ³ /kl	360		360	
溶剤脱芳香族(フルフラール)				
溶剤/油 vol比	—		—	
温度 °C	—		—	
潤 滑 油 基 油	A	B	A	B
動粘度 mm ² /s(@40°C)	20.9	8.11	20.8	8.10
粘度指数	116	100	118	108
流動点 °C	- 22.5	- 25.0	- 22.5	- 25.0
引火点 °C	220	195	221	196
アニリン点 °C	114.2	101.8	114.0	101.3
組 成				
芳香族分 wt%	0.55	0.75	0.75	0.95
安 定 性				
熱安定性試験* ¹⁾				
判定	合格	合格	合格	合格
酸化安定性試験* ²⁾ (min)	432	415	429	380
耐候性試験				
判定	合格 (○)	合格 (○)	合格 (○)	合格 (○)

[0145]

[Table 4]

原 料		比較例 3	比較例 4
		HGO/VGO	HGO/VGO
原料比率		5/5	5/5
水素化分解			
全圧力	kg/cm ²	160	160
LHSV	h ⁻¹	1.0	1.0
温度	℃	380	380
分解率	wt %	55	55
溶剤脱ろう			
溶剤／油	vol 比	3	3
温度	℃	- 30	- 30
水素化			
温度	℃	290	-
全圧力	Kg/cm ²	160	-
LHSV	h ⁻¹	0.5	-
水素／油比	Nm ³ /kl	360	-
溶剤脱芳香族(フルフラール)			
溶剤／油	vol 比	-	2.0
温度	℃	-	110
潤 滑 油 基 油		A	A
動粘度	mm ² /s(④40℃)	20.7	20.8
粘度指数		115	115
流動点	℃	- 22.5	- 22.5
引火点	℃	220	212
アニリン点	℃	113.9	113.3
組 成			
芳香族分	wt %	3.5	6.3
安 定 性			
熱安定性試験 ^{*1)}			
判定		合格	合格
酸化安定性試験 ^{*2)} (min)		407	360
耐候性試験			
判定		不合格 (△)	不合格 (×)

*1) JIS K It is based on 2540 (evaluation 12 hours after 170 degree-Cx).

*2) ASTM D It is based on 2272 (additive 0.5wt% addition).

*3) Evaluation 96 hours after being based on the photodegradation accelerated test equipment indicated by JP,1-94241,A. O showed by considering the case where the sample oil after examining all is transparence as success, and when it was alike to that extent, there was cloudiness more and there were ** and precipitate, x showed the rejection.

[Translation done.]